

Historical Flood Demonstration: A Proof-of-Concept for New Observing Strategies, Technologies, and the NOS Testbed

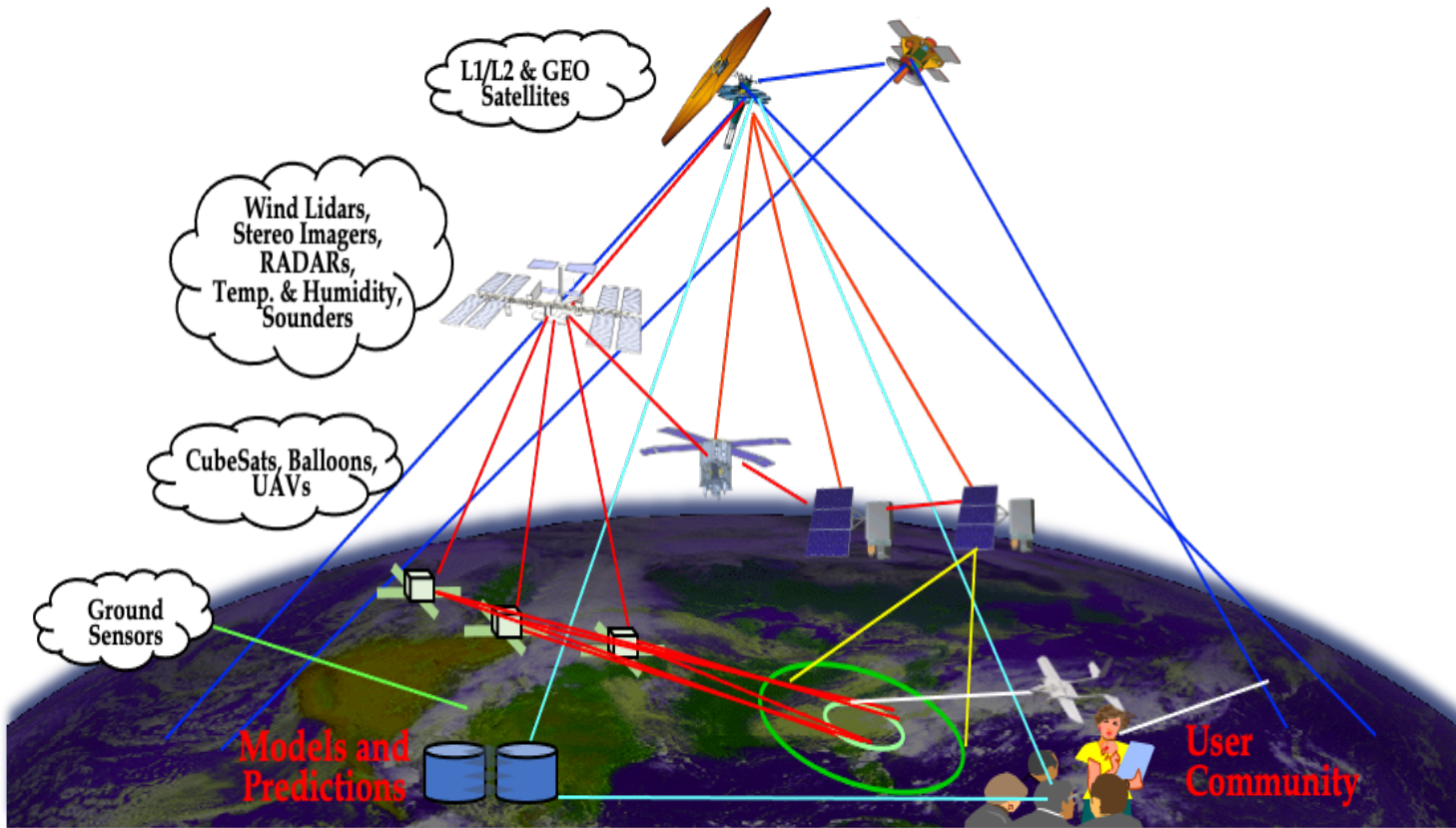
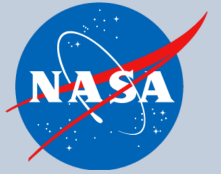
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Jet Propulsion Laboratory, California Institute of Technology

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New Observing Strategies



*Novel Observing Concept Design
Timely Adaptive Capture of Science Events*

Actively acquire data in coordination with other sensors and models in response to measurement needs and/or science events

Increase understanding and predictability of dynamic events on Earth

Provide a more Complete Picture of Earth System Processes

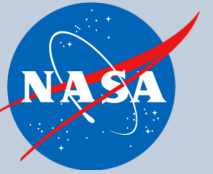
New Observing Strategies Testbed



The NOS Testbed is a software environment for:

- Validating observing system concepts and technologies
- Demonstrating new observing strategies
- Trade studies, Evaluation, and Socialization

A First Use Case

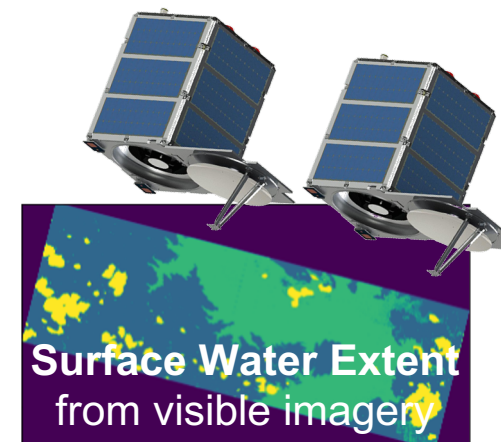
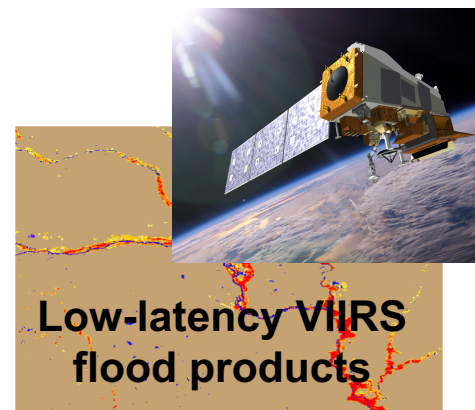
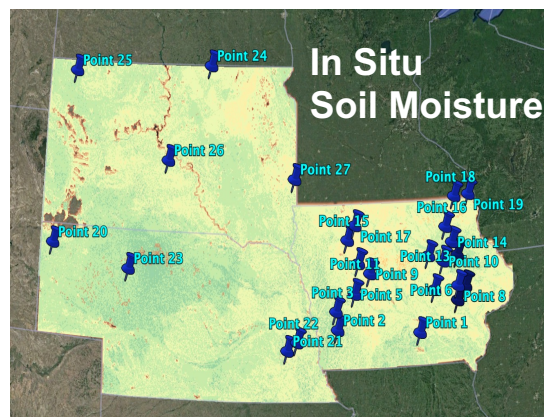
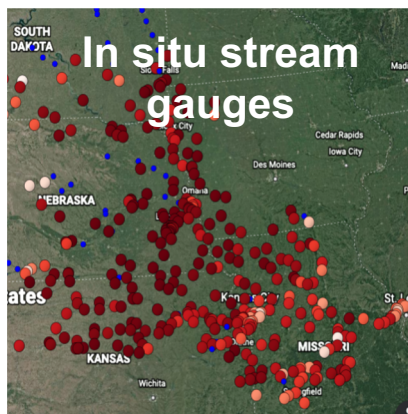


- Demonstrate a New Observing Strategy that Coordinates in situ sensors, remote sensing, and models to better observe a flood.
- Demonstrate the concept running in the NOS testbed as proof-of-feasibility
- Observations are simulated with historical data from the Midwest flood of 2019. Scenario focuses on the few days near the peak flood.
- This is a first 'proof-of-feasibility' for the testbed. Other scenarios may be considered in the future.



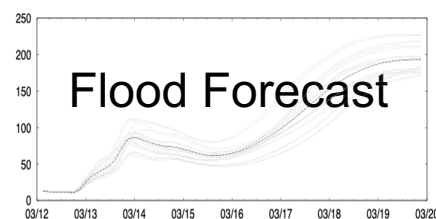
Credit: Air Force

New Observing Strategy for Flood Scenario



Modeling

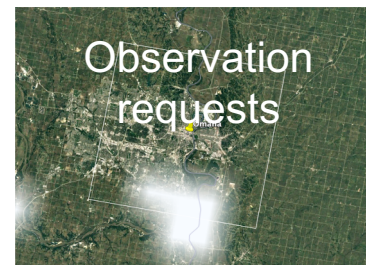
High Stream Flow



Trigger Analysis

Expedited flood product requests

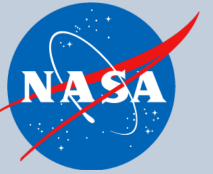
Observation requests



Retasking

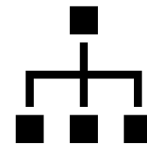
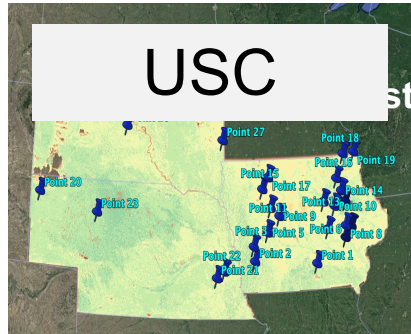
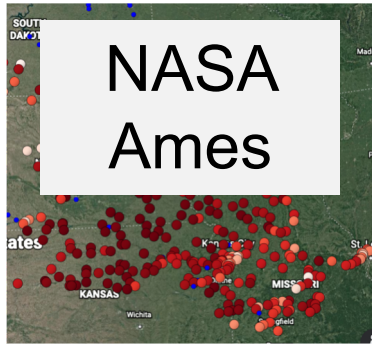
Schedule observations taking into account observability and availability constraints

New Observing Strategy Elements



- Flood scenario is an example of how satellite and in situ sensors can be directed to acquire high value observations of predicted events.
- Retasks commercial satellites to acquire higher-resolution (space and time) images of predicted high-utility flood regions, while flood peaks are occurring.
- Requests low-latency VIIRS product for assimilation when floods are likely (via AWS Ground Station as a Service and Stream Gage triggers)
- Upscaled in-situ sensors provide soil moisture data with larger spatial coverage.

Simulated in NOS Testbed



Message broker
(SMCE)

Stevens

NOS-T
Manager



Goddard

Modeling



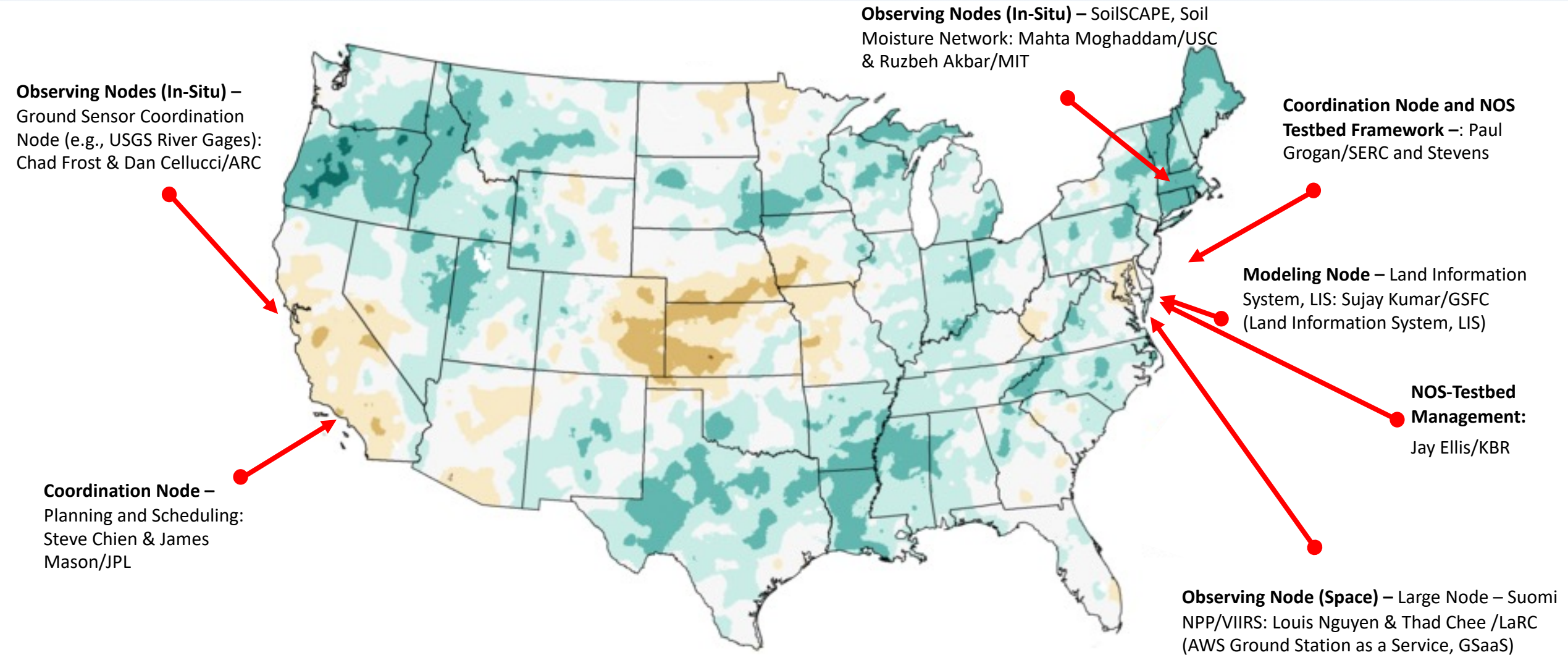
JPL

Retasking

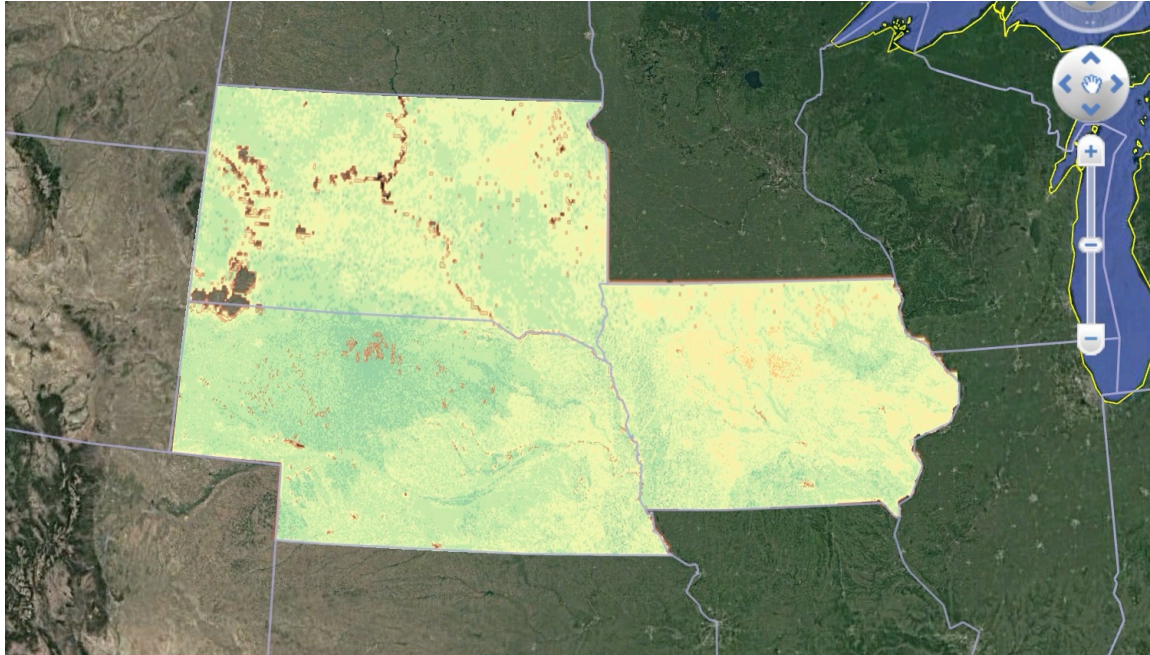
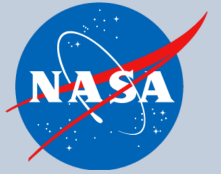


- Observations simulated with historical data
- Nodes run on distributed servers
- Communicate via a Publish-Subscribe message broker.

Testbed Nodes

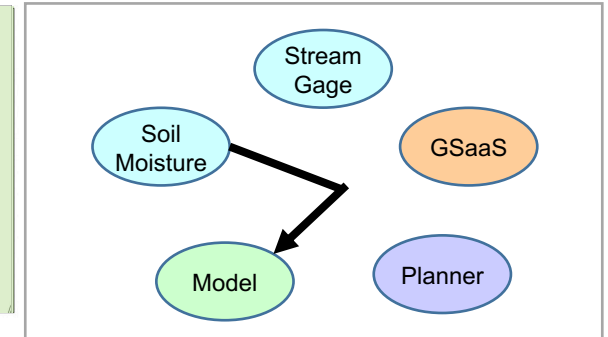
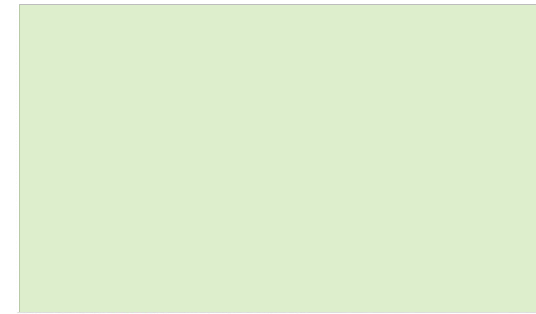


Upscaled In Situ Soil Moisture



Generate upscaled soil-moisture product from in-situ network

Simulation Time: 2019-03-15 06:00Z



Retasking Messages (topic is 'nhost/planner')

```
2021/3/1 12:5:5.843 ["message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc"]
2021/3/1 12:4:8.277 ["message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc"]
2021/3/1 12:3:11.125 ["message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc"]
2021/3/1 12:2:13.65 ["message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc"]
Incoming Messages
```

Forecast (Model) Messages (topic is 'nhost/model/#')

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2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.406 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
```

NWIS Messages (topic is 'nwis/#')

Incoming Messages

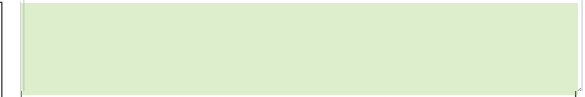
NOS-T Manager Messages (topic is 'nhost/manager/#')

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2021/3/1 12:5:31.12 ["taskingParameters": {"simStopTime": "2019-03-19T15:00:00:00"}]
2021/3/1 12:5:18.630 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00:00:00", "time": "2021-03-15T16:05:14.676674+00:00"}]
2021/3/1 12:5:3.835 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
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GSaaS VIIRS Messages (topic is 'nhost/GSaaS')

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2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully!"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and PolarGrid files to Amazon S3 for distribution"
```

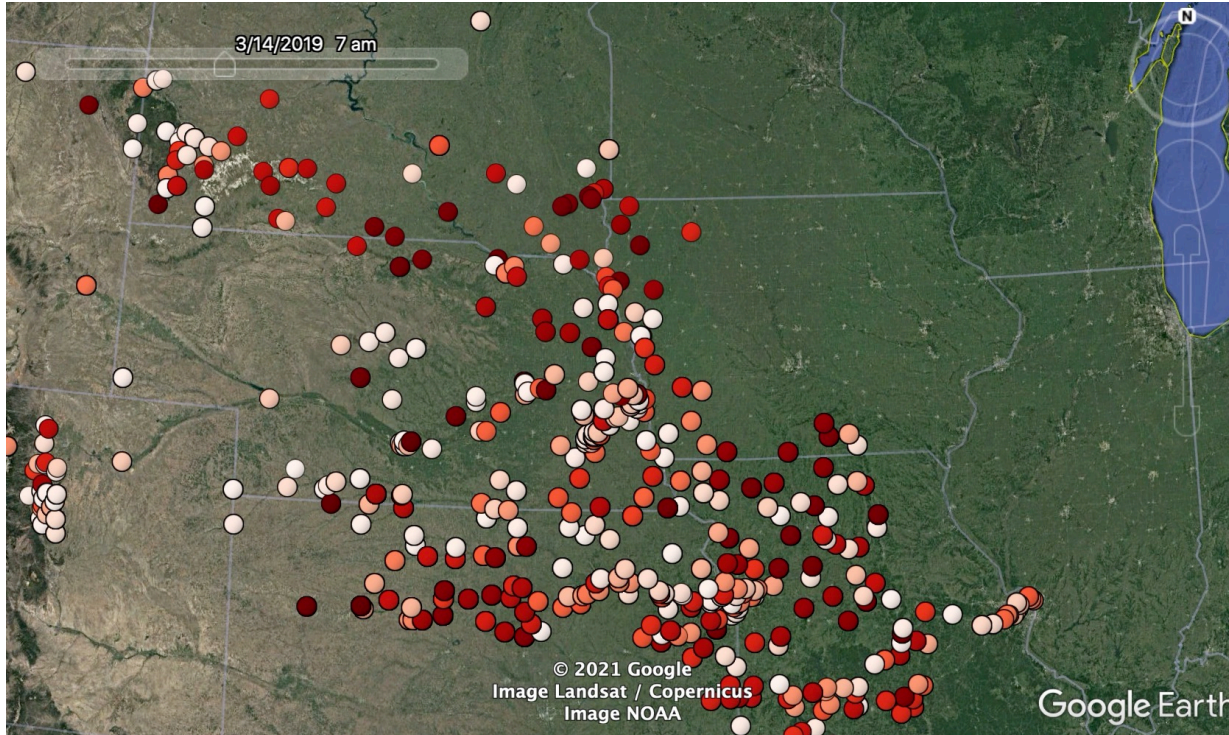
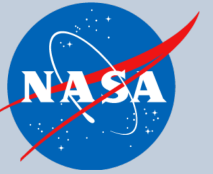
Soil Moisture Messages (topic is 'nhost/soilmoisture/#')



All Messages As Text (topic is '#')

```
2021/3/1 17:39:27.563 ["message": "new_file_uploaded"]
2021/3/1 17:39:21.641 ["message": "new_file_uploaded", "filepath": "files/swe_output.nc"]
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2021/3/1 17:23:44.882 ["message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc"]
2021/3/1 15:28:46.144 ["name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050/", "subscriptions": ["nhost/manager/#", "nhost/fire/#", "nhost/ground/#", "type": "client"]}]
```

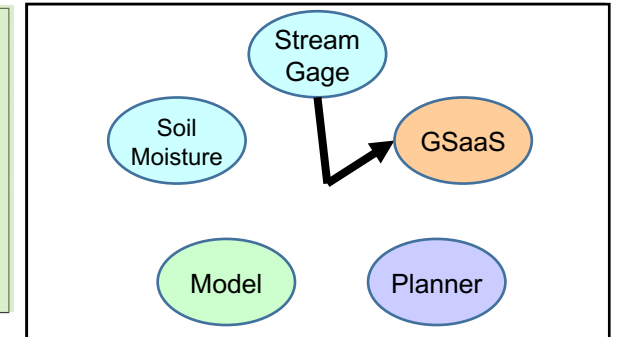

In Situ Stream Gage Sensors



Stream Gauge Data every 6 hours
Watch for unusually high flows

Simulation Time: 2019-03-15 06:00Z

```
2021/3/1 12:5:35.174 [SOIL] Soil System Closing...1
2021/3/1 12:5:35.173 [SOIL] Soil System Closing...2
2021/3/1 12:5:35.88 [SOIL] Soil System Closing...3
2021/3/1 12:5:31.64 [CLOCK] End of simulation.
2021/3/1 12:5:23.371 [GSaaS]: Processing VIIRS Flood Product Completed.
2021/3/1 12:5:19.804 [SOIL] Waiting for 00Z. Current Time is: 12
2021/3/1 12:5:19.156 [GSaaS]: Receiving VIIRS Direct Broadcast.
2021/3/1 12:5:19.155 [GSaaS]: Tasking Amazon GS to receive next VIIRS overpass.
2021/3/1 12:5:19.95 [CLOCK]: Received simulation time tick, simulation time is now: 2019-03-19T12:00:00
2021/3/1 12:5:5.851 [model]: Sent 'new_trigger' message to Planner system
2021/3/1 12:5:5.856 [model]: Forecast Triggers completed at 2019-03-19 at 06:00:00
2021/3/1 12:5:4.954 [CLOCK]: Waiting for 00Z. Current Time is: 06
2021/3/1 12:5:4.337 [CLOCK]: Received simulation time tick, simulation time is now: 2019-03-19T06:00:00
2021/3/1 12:4:54.317 [model]: Performing data assimilation and forecasting at 2019-03-19 at 00:00:00
2021/3/1 12:4:50.557 [SOIL] Download for day 19. URL:
https://landscape.usc.edu/data/NOS/KML/20190319_predict_sm.kmz
2021/3/1 12:4:50.495 [SOIL] Sending soil moisture KMZ files.
2021/3/1 12:4:49.893 [CLOCK]: Received simulation time tick, simulation time is now: 2019-03-19T00:00:00
2021/3/1 12:4:37.55 [model]: Finished downloading VIIRS Flood File from GSaaS:
WATER_COM_VIIRS_Pf_SVI_d20190318_3559_1780_5_001day_169.tif
2021/3/1 12:4:37.33 [model]: Received VIIRS Flood File URL from GSaaS:
WATER_COM_VIIRS_Pf_SVI_d20190318_3559_1780_5_001day_169.tif
```



Retasking Messages (topic is 'nhost/planner')

```
2021/3/1 12:5:5.843 ["message": "new_trigger", "filepath": "firedrop/run/2019031900/trigger_201903190000.nc"]
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2021/3/1 12:2:13.65 ["message": "new_trigger", "filepath": "firedrop/run/2019031600/trigger_201903160000.nc"]
Incoming Messages
```

NWIS-T Manager Messages (topic is 'nhost/manager/*')

```
2021/3/1 12:5:31.12 ["taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"}]
2021/3/1 12:5:18.630 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
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2021/3/1 12:5:3.835 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
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2021/3/1 12:4:49.471 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
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Forecast (Model) Messages (topic is 'nhost/model/*')

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2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.406 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
```

GSaaS VIIRS Messages (topic is 'nhost/GSaaS')

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2021/3/1 12:5:23.149 ["Completed processing of the SDR VIIRS algorithm successfully"]
2021/3/1 12:5:22.976 ["Uploading level 3 fire imagery to Amazon S3 for distribution"]
2021/3/1 12:5:22.826 ["L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"]
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2021/3/1 12:5:22.291 ["Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"]
```

NWIS Messages (topic is 'nwis/*')

```

Incoming Messages

```

Soil Moisture Messages (topic is 'nhost/soilmoisture/*')

```

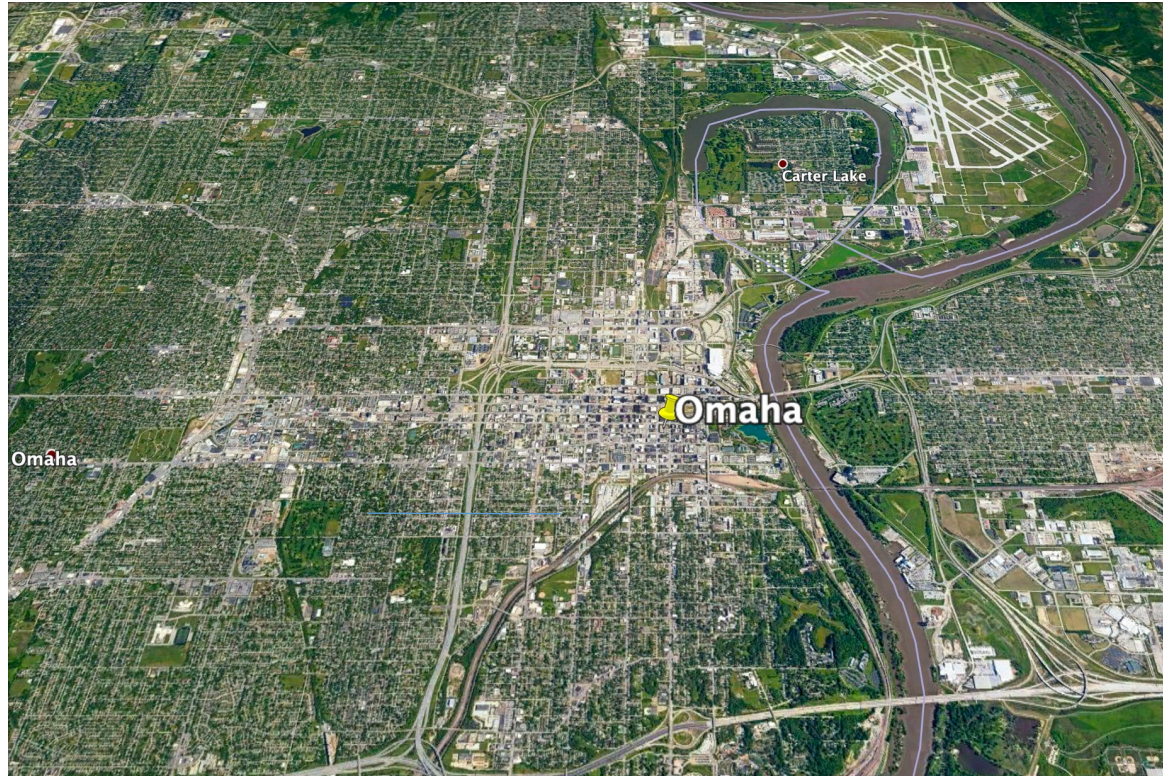
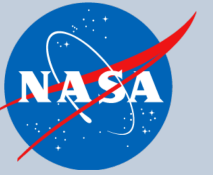
Incoming Messages

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All Messages As Text (topic is '#')

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2021/3/1 17:23:44.882 ["message": "new_trigger", "filepath": "firedrop/baseline/2019031600/trigger_201903160000.nc"]
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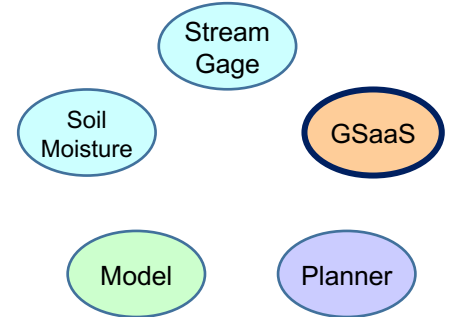

Schedule AWS Ground Station for urgent downlink of VIIRS direct broadcast data



Schedule AWS Ground Station to receive NPP direct broadcast at 17Z

Simulation Time: 2019-03-15 12:00Z

```
2021/3/5 17:2:59.198 [SOIL] Download for day 15. URL: http
2021/3/5 17:2:59.198 [SOIL] Sending soil moisture KMZ file
2021/3/5 17:2:58.792 [CLOCK]: Received simulation time tick
2021/3/5 17:2:58.117 [NWIS]: Publishing Trigger Data for 20
2021/3/5 17:2:47.727 [CLOCK]: Start of demo simulation.
2021/3/5 17:2:44.961 [SOIL] Soil Moisture system ready.
2021/3/5 17:2:44.823 [SOIL] starting...2
2021/3/5 17:2:44.283 [SOIL] starting...1
2021/3/5 17:2:43.921 [SOIL] starting...0
2021/3/5 17:2:43.427 [SOIL] Soil Moisture system starting..
Incoming Messages
```



```
2021/3/1 12:5:5.843 {"message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc"}
2021/3/1 12:4:8.277 {"message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc"}
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Incoming Messages
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Forecast (Model) Messages (topic is 'nhost/model/*')

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2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.406 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
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GSaaS VIIRS Messages (topic is 'nhost/GSaaS/*')

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NWIS Messages (topic is 'nhost/nwis/*')

Incoming Messages

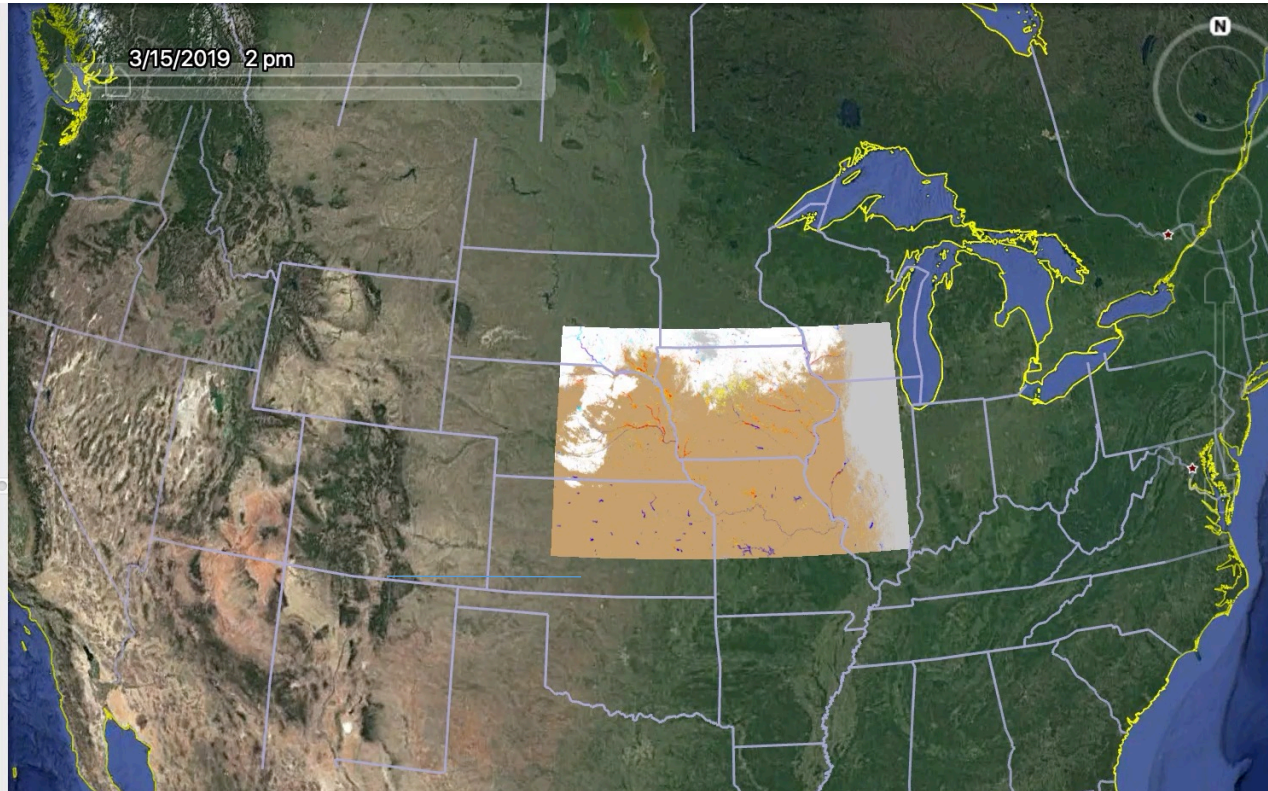
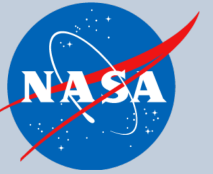
Soil Moisture Messages (topic is 'nhost/soilmoisture/*')

Incoming Messages

All Messages As Text (topic is '#')

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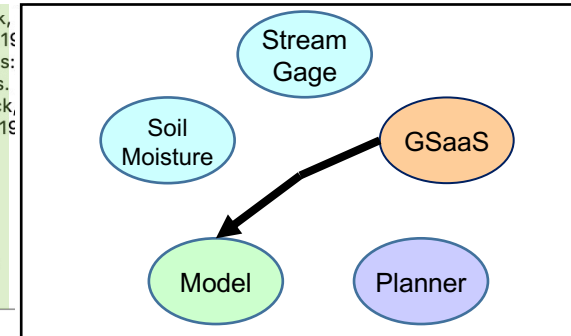

Downlink and Generate VIIRS Flood Extent Product



Downlink via AWS Ground Station
Process flood product in the cloud

Simulation Time: 2019-03-15 18:00Z

```
2021/3/5 17:3:11.872 [CLOCK]: Received simulation time tick,
2021/3/5 17:3:11.868 [NWIS]: Publishing Trigger Data for 2019
2021/3/5 17:2:59.198 [SOIL] Download for day 15. URL: https:
2021/3/5 17:2:59.198 [SOIL] Sending soil moisture KMZ files.
2021/3/5 17:2:58.792 [CLOCK]: Received simulation time tick,
2021/3/5 17:2:58.117 [NWIS]: Publishing Trigger Data for 2019
2021/3/5 17:2:47.727 [CLOCK]: Start of demo simulation.
2021/3/5 17:2:44.961 [SOIL] Soil Moisture system ready.
2021/3/5 17:2:44.823 [SOIL] starting...2
2021/3/5 17:2:44.283 [SOIL] starting...1
2021/3/5 17:2:43.921 [SOIL] starting...0
2021/3/5 17:2:43.427 [SOIL] Soil Moisture system starting...
Incoming Messages
```



Retasking Messages (topic is 'nost/planner')

```
2021/3/1 12:5:5.843 {"message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc"}
2021/3/1 12:4:8.277 {"message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc"}
2021/3/1 12:3:11.125 {"message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc"}
2021/3/1 12:2:13.65 {"message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc"}
Incoming Messages
```

NOS-T Manager Messages (topic is 'nost/manager/*')

```
2021/3/1 12:5:31.12 {"taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"}}
2021/3/1 12:5:18.630 {"name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"}}
2021/3/1 12:5:3.835 {"name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"}}
2021/3/1 12:4:49.471 {"name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"}}
```

Forecast (Model) Messages (topic is 'nost/model/*')

```
2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
```

GSaaS VIIRS Messages (topic is 'nost/GSaaS')

```
2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"
```

NWIS Messages (topic is 'nwis/*')

Incoming Messages

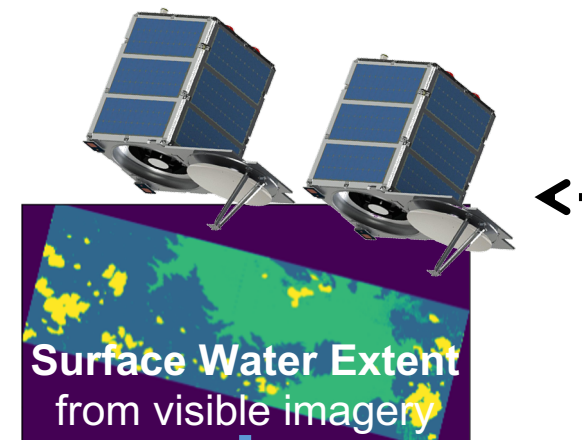
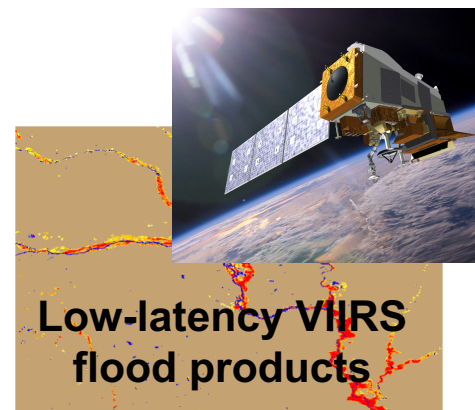
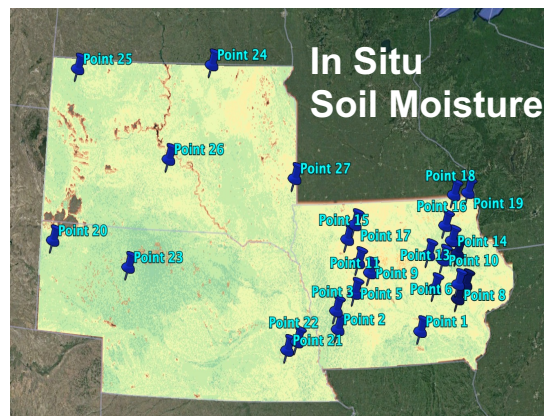
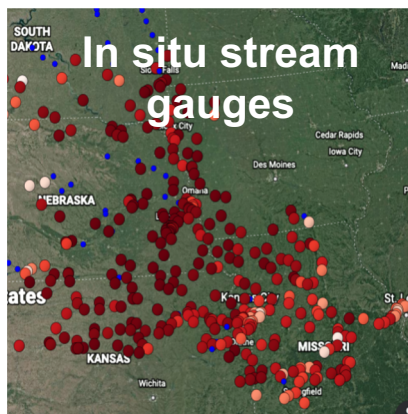
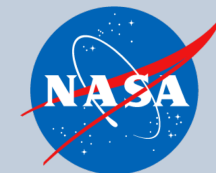
Soil Moisture Messages (topic is 'nost/soilmoisture/*')

Incoming Messages

All Messages As Text (topic is '#')

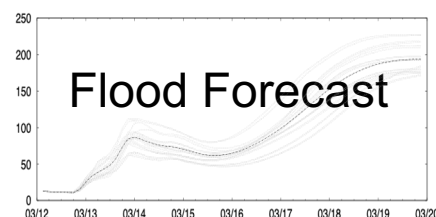
```
2021/3/1 17:39:27.563 {"message": "new_file_uploaded"}
2021/3/1 17:39:21.641 {"message": "new_file_uploaded", "filepath": "files/swe_output.nc"}
2021/3/1 17:31:39.894 [model]: Received new input, starting processing
2021/3/1 17:31:37.845 {"message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc"}
2021/3/1 17:24:17.687 [model]: Received new input, starting processing
2021/3/1 17:23:44.882 {"message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc"}
2021/3/1 15:28:46.144 {"name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": [{"nost/manager/*", "nost/fire/*", "nost/ground/*"}, "type": "client"]}}
```

New Observing Strategy for Flood Scenario



Modeling and Analysis

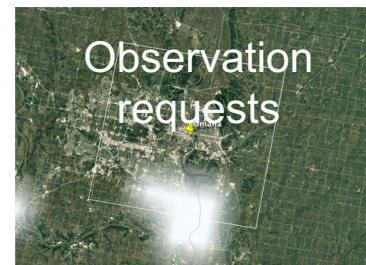
High Stream Flow



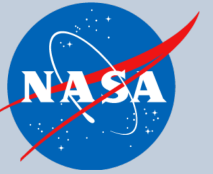
Triggers

Expedited flood product requests

Observation requests

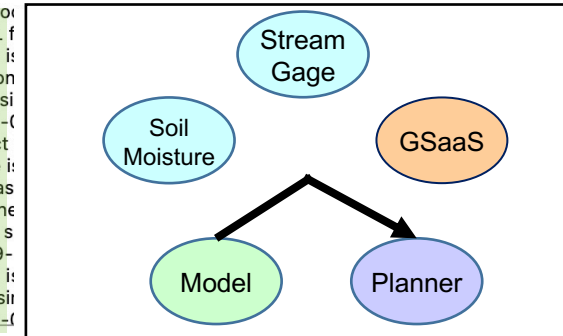


Assimilate and Forecast: Flood “Triggers”



Simulation Time: 2019-03-16 00:00Z

```
2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS Floo
2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URL f
2021/3/5 17:3:41.576 [SOIL] Waiting for hour 00. Current Time i
2021/3/5 17:3:41.574 [GSaaS]: Sent VIIRS Flood File Notification
2021/3/5 17:3:41.567 [CLOCK]: Received simulation time tick, si
2021/3/5 17:3:41.561 [NWIS]: Publishing Trigger Data for 2019-(
2021/3/5 17:3:30.956 [GSaaS]: Processing VIIRS Flood Product
2021/3/5 17:3:27.290 [SOIL] Waiting for hour 00. Current Time i
2021/3/5 17:3:25.849 [GSaaS]: Receiving VIIRS Direct Broadcas
2021/3/5 17:3:25.845 [GSaaS] Tasking Amazon GS to receive ne
2021/3/5 17:3:25.844 [CLOCK]: Received simulation time tick, s
2021/3/5 17:3:25.837 [NWIS]: Publishing Trigger Data for 2019-
2021/3/5 17:3:12.847 [SOIL] Waiting for hour 00. Current Time i
2021/3/5 17:3:11.872 [CLOCK]: Received simulation time tick, si
2021/3/5 17:3:11.868 [NWIS]: Publishing Trigger Data for 2019-(
```



```
receiving messages (topic is 'instreamgates')
2021/3/1 12:5:5.843 ("message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc")
2021/3/1 12:4:8.277 ("message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc")
2021/3/1 12:3:11.125 ("message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc")
2021/3/1 12:2:13.65 ("message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc")
Incoming Messages
```

```
NOS-T Manager Messages (topic is 'nosta/manager/*')
2021/3/1 12:5:31.12 ("taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"})
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"})
2021/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"})
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"})
```

Forecast (Model) Messages (topic is 'nosta/model/*')

```
2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
```

GSaaS VIIRS Messages (topic is 'nosta/GSaaS')

```
2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"
```

NWIS Messages (topic is 'nosta/nwis/*')

Incoming Messages

Soil Moisture Messages (topic is 'nosta/soilmoisture/*')

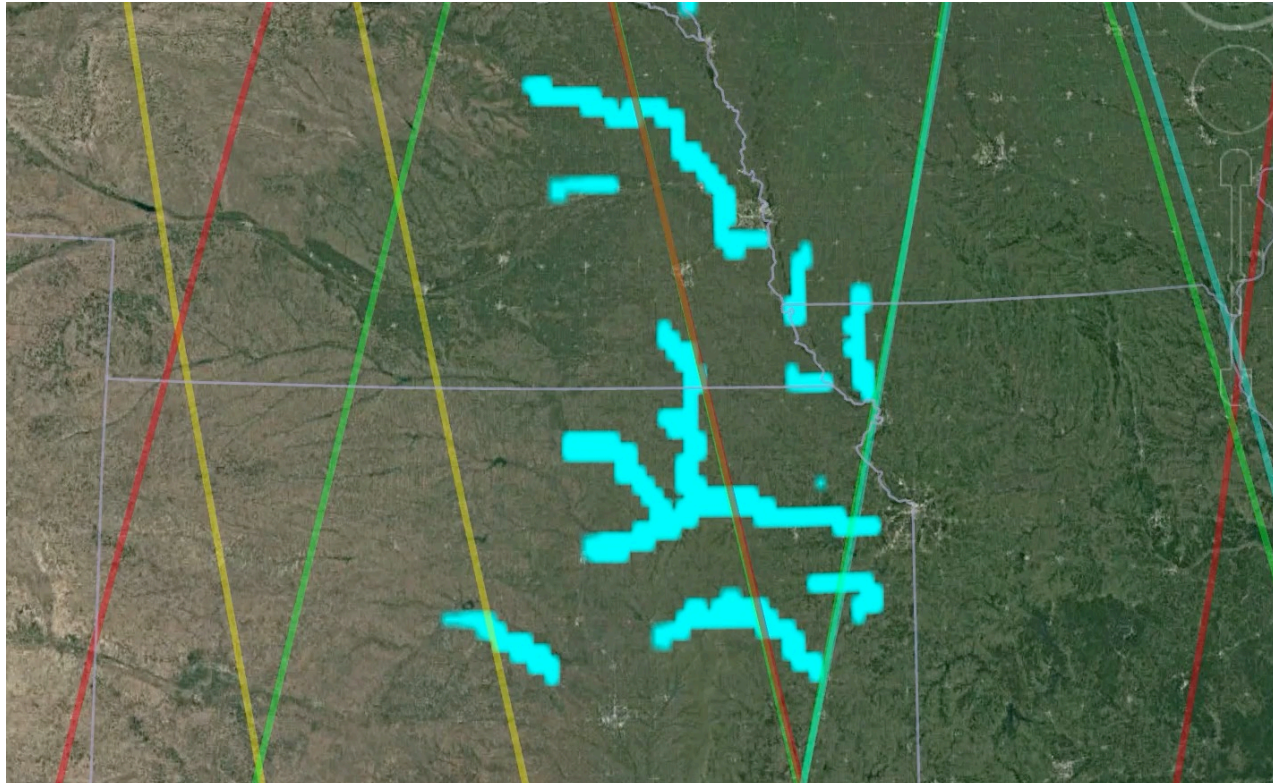
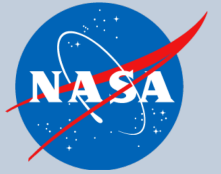
Incoming Messages

All Messages As Text (topic is '#')

```
2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:38.894 [model] Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 17:24:17.687 [model] Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 16:28:46.144 ("name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050/", "subscriptions": [{"nosta/manager/#", "nosta/fire/#", "nosta/ground/#"}, "type": "client"]})
```

Forecast peak flows
in 6-hour blocks

Schedule Satellites to observe peaks



Schedule Satellites to image
predicted peak flows

Simulation Time: 2019-03-16 06:00Z

```
2021/3/5 17:4:0.77 [MODEL]: Performing data assimilation and
2021/3/5 17:3:55.879 [SOIL] Download for day 16. URL: https:
2021/3/5 17:3:55.871 [SOIL] Sending soil moisture KMZ files.
2021/3/5 17:3:55.864 [CLOCK]: Received simulation time tick,
2021/3/5 17:3:55.857 [NWIS]: Publishing Trigger Data for 2019
2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS FI
2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URL
2021/3/5 17:3:41.576 [SOIL] Waiting for hour 00. Current Time
2021/3/5 17:3:41.574 [GSaaS]: Sent VIIRS Flood File Notificati
2021/3/5 17:3:41.567 [CLOCK]: Received simulation time tick,
2021/3/5 17:3:41.561 [NWIS]: Publishing Trigger Data for 2019
2021/3/5 17:3:30.956 [GSaaS]: Processing VIIRS Flood Produc
2021/3/5 17:3:27.290 [SOIL] Waiting for hour 00. Current Time
2021/3/5 17:3:25.849 [GSaaS]: Receiving VIIRS Direct Broadc
2021/3/5 17:3:25.845 [GSaaS]: Tasking Amazon GS to receive
```

Retasking Messages (topic is 'nost/planner')

```
2021/3/1 12:5:5.843 ("message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc")
2021/3/1 12:4:8.277 ("message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc")
2021/3/1 12:3:11.125 ("message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc")
2021/3/1 12:2:13.65 ("message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc")
Incoming Messages
```

Forecast (Model) Messages (topic is 'nost/model/#')

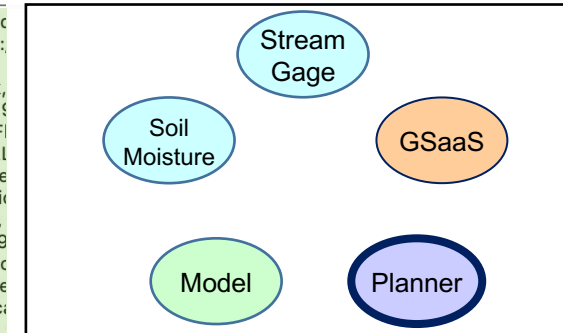
```
2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
```

NWIS Messages (topic is 'nwis/#')

Incoming Messages

All Messages As Text (topic is '#')

```
2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:38.894 [model]: Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 17:24:17.687 [model]: Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 16:28:46.144 ("name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": ["nost/manager/#", "nost/fire/#", "nost/ground/#"], "type": "client"})
```



NOS-T Manager Messages (topic is 'nost/manager/#')

```
2021/3/1 12:5:31.12 ("taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"})
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"})
2021/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"})
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"})
```

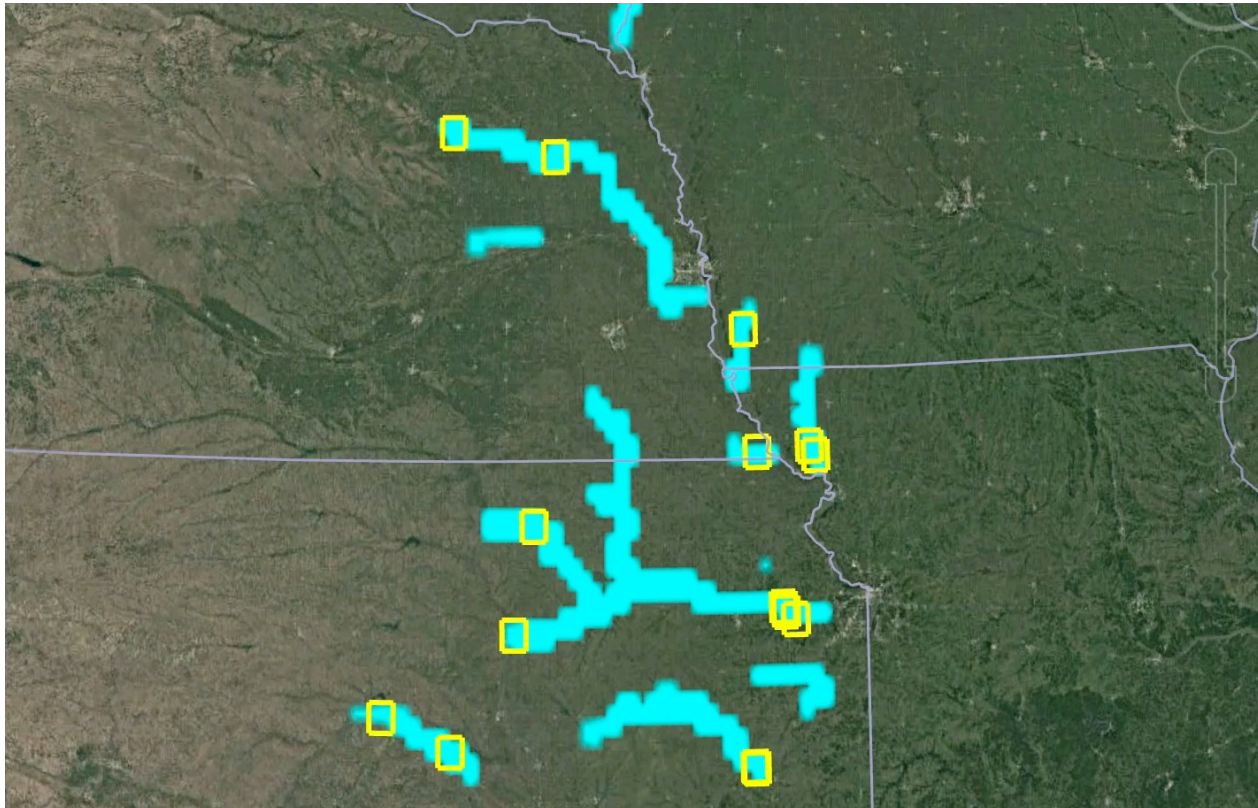
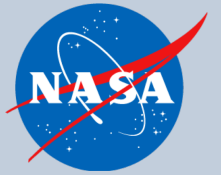
GSaaS VIIRS Messages (topic is 'nost/GSaaS')

```
2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"
```

Soil Moisture Messages (topic is 'nost/soilmoisture/#')

Incoming Messages

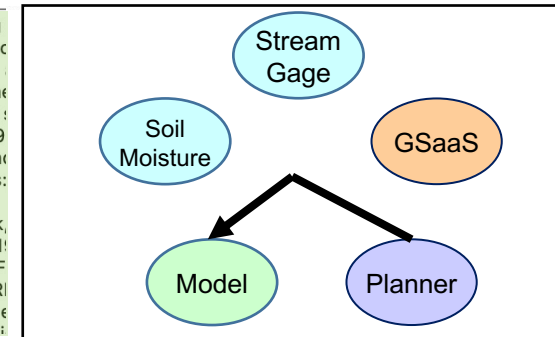
Satellite Images Acquired Derive Surface Water Extent



Schedule satellites to image
predicted peak flows

Simulation Time: 2019-03-16 06:00Z

```
2021/3/5 17:4:12.339 [RETASK]: Received new input, starting
2021/3/5 17:4:12.339 [MODEL]: Sent 'new_trigger' message to
2021/3/5 17:4:12.330 [MODEL]: Forecast Triggers completed
2021/3/5 17:4:12.328 [SOIL]: Waiting for hour 00. Current Time
2021/3/5 17:4:9.646 [CLOCK]: Received simulation time tick,
2021/3/5 17:4:9.633 [NWIS]: Publishing Trigger Data for 2019
2021/3/5 17:4:0.77 [MODEL]: Performing data assimilation and
2021/3/5 17:3:55.879 [SOIL]: Download for day 16. URL: https:
2021/3/5 17:3:55.871 [SOIL]: Sending soil moisture KMZ files.
2021/3/5 17:3:55.864 [CLOCK]: Received simulation time tick,
2021/3/5 17:3:55.857 [NWIS]: Publishing Trigger Data for 201
2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS F
2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File UR
2021/3/5 17:3:41.576 [SOIL]: Waiting for hour 00. Current Time
2021/3/5 17:2:41.574 [GSaaS]: Sent VIIRS Flood File Notificati
```



Retasking Messages (topic is 'nost/planner')

```
2021/3/1 12:5:5.843 ("message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc")
2021/3/1 12:4:8.277 ("message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc")
2021/3/1 12:3:11.125 ("message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc")
2021/3/1 12:2:13.65 ("message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc")
Incoming Messages
```

Forecast (Model) Messages (topic is 'nost/model/#')

```
2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
```

NWIS Messages (topic is 'nwis/*')

Incoming Messages

NOS-T Manager Messages (topic is 'nost/manager/*')

```
2021/3/1 12:5:31.12 ("taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"})
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"})
2021/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"})
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"})
```

GSaaS VIIRS Messages (topic is 'nost/GSaaS')

```
2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"
```

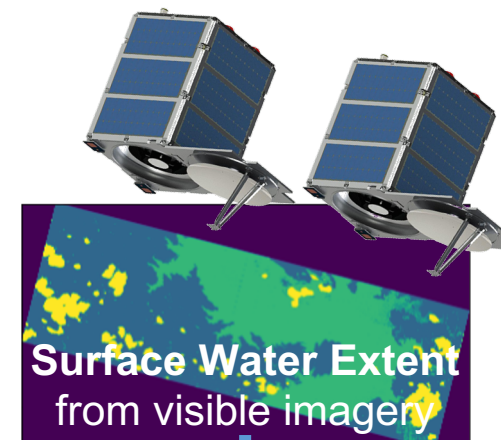
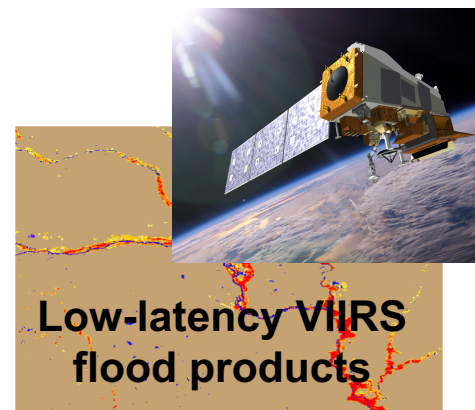
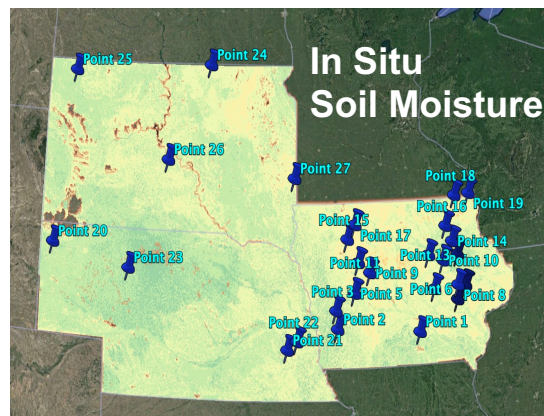
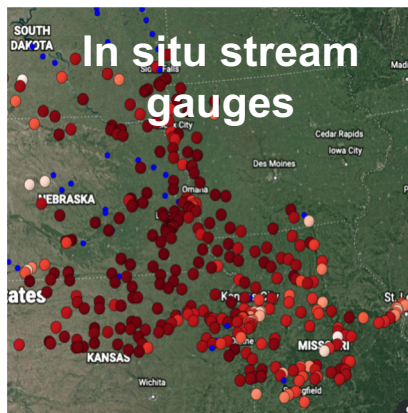
Soil Moisture Messages (topic is 'nost/soilmoisture/*')

Incoming Messages

All Messages As Text (topic is '#')

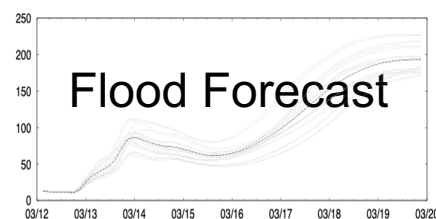
```
2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:39.894 [model]: Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 17:24:17.687 [model]: Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 16:28:46.144 ("name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": ["nost/manager/#", "nost/fire/#", "nost/ground/#"], "type": "client"})
```


New Observing Strategy for Flood Scenario



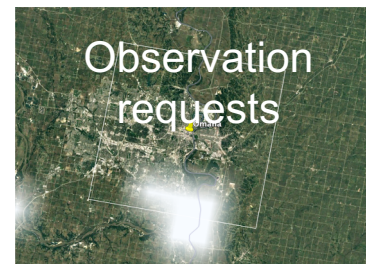
Modeling and Analysis

High Stream Flow

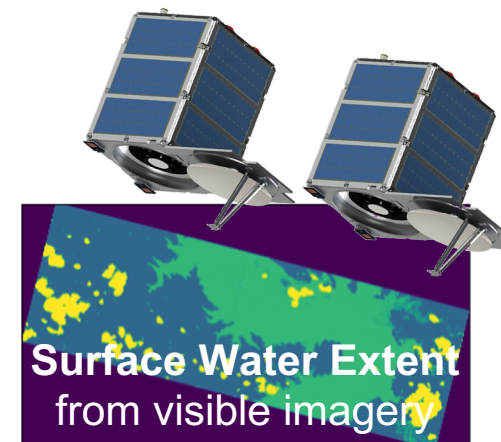
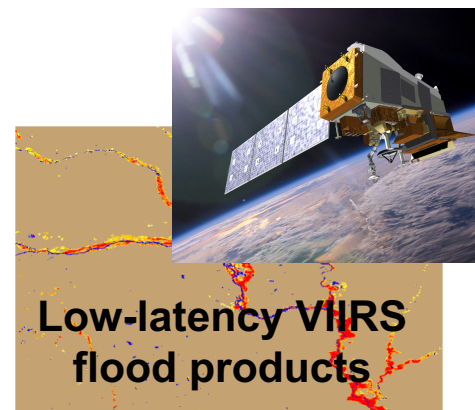
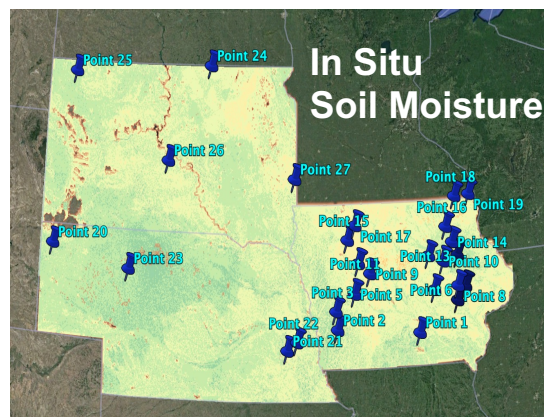
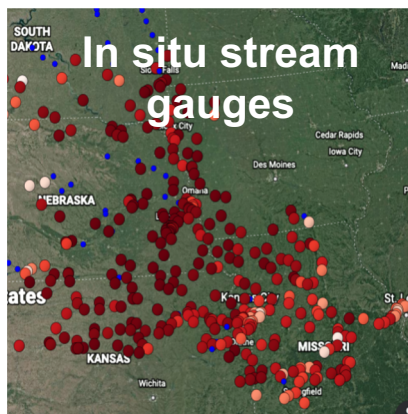
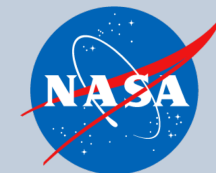


Triggers

Expedited flood product requests

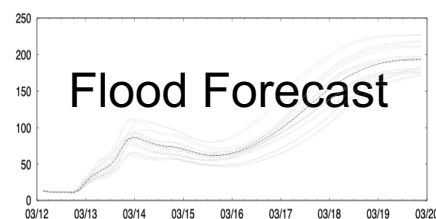


New Observing Strategy for Flood Scenario



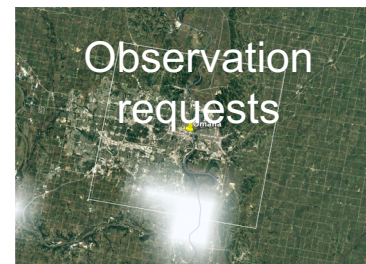
Modeling and Analysis

High Stream Flow



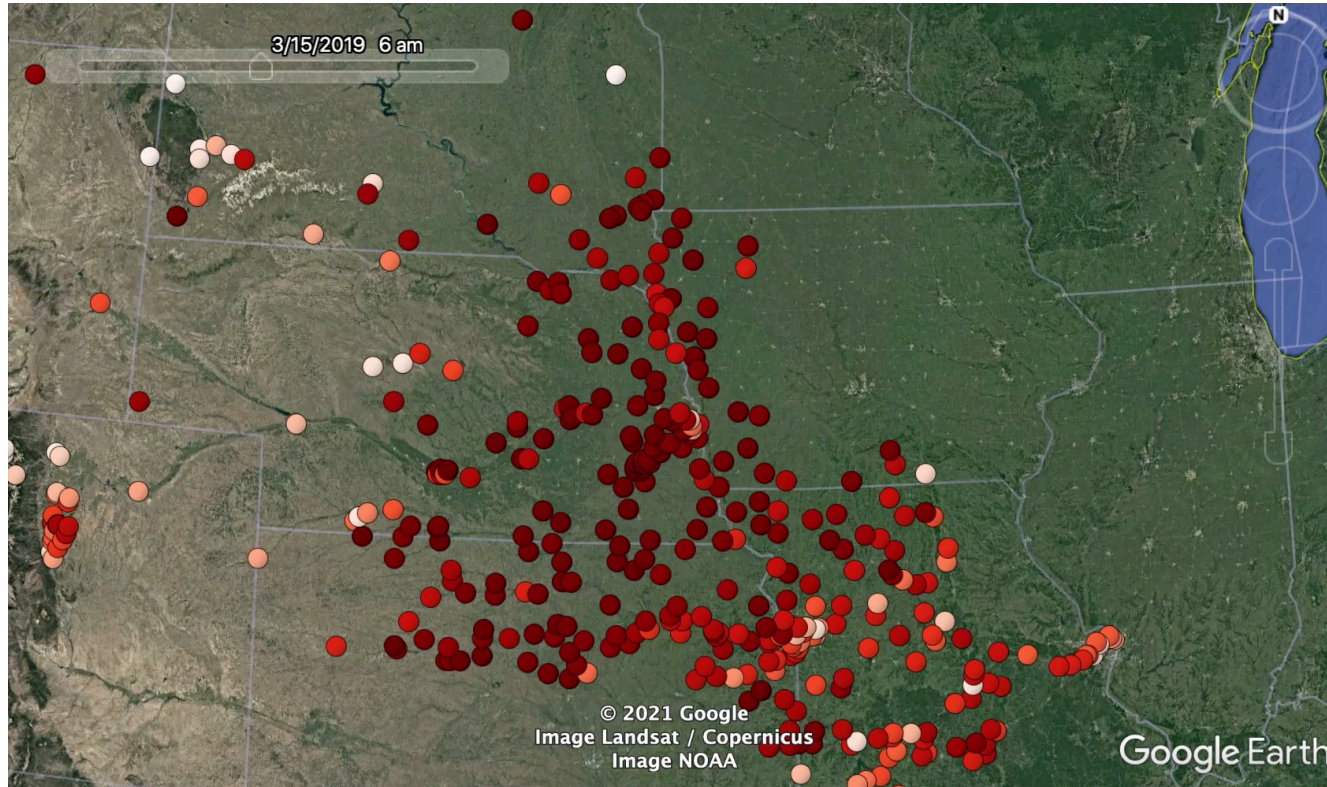
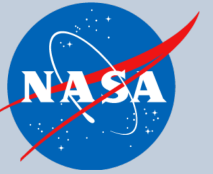
Triggers

Expedited flood product requests



REPEAT

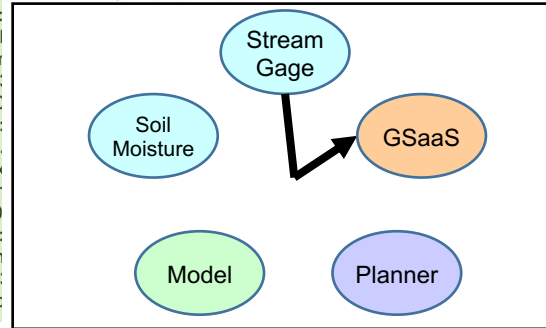
Stream Gauge Triggers



Detects unusually high flows

Simulation Time: 2019-03-16 06:00Z

2021/3/5 17:3:41.576 [SOIL] Waiting for hour 00. Current Time is:
2021/3/5 17:3:41.574 [GSaaS]: Sent VIIRS Flood File Notification I
2021/3/5 17:3:41.567 [CLOCK]: Received simulation time tick, sir
2021/3/5 17:3:41.561 [NWIS]: Publishing Trigger Data for 2019-0
2021/3/5 17:3:30.956 [GSaaS]: Processing VIIRS Flood Product C
2021/3/5 17:3:27.290 [SOIL] Waiting for hour 00. Current Time is:
2021/3/5 17:3:25.849 [GSaaS]: Receiving VIIRS Direct Broadcast.
2021/3/5 17:3:25.845 [GSaaS] Tasking Amazon GS to receive nex
2021/3/5 17:3:25.844 [CLOCK]: Received simulation time tick, sir
2021/3/5 17:3:25.837 [NWIS]: Publishing Trigger Data for 2019-0
2021/3/5 17:3:12.847 [SOIL] Waiting for hour 00. Current Time is:
2021/3/5 17:3:11.872 [CLOCK]: Received simulation time tick, sim
2021/3/5 17:3:11.868 [NWIS]: Publishing Trigger Data for 2019-0
2021/3/5 17:2:59.198 [SOIL] Download for day 15. URL: https://sc
2021/3/5 17:2:59.198 [SOIL] Sending soil moisture KMZ file



Retasking Messages (topic is 'nost/manager')

2021/3/1 12:5:5.843 ("message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc")
2021/3/1 12:4:8.277 ("message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc")
2021/3/1 12:3:11.125 ("message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc")
2021/3/1 12:2:13.65 ("message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc")
Incoming Messages

NOS-T Manager Messages (topic is 'nost/manager')

2021/3/1 12:5:31.12 ("taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"},
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"}
2021/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"}
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"}
Incoming Messages

Forecast (Model) Messages (topic is 'nost/model')

2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
Incoming Messages

GSaaS VIIRS Messages (topic is 'nost/GSaaS')

2021/3/1 12:5:23.145 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"
Incoming Messages

NWIS Messages (topic is 'nwis')

Incoming Messages

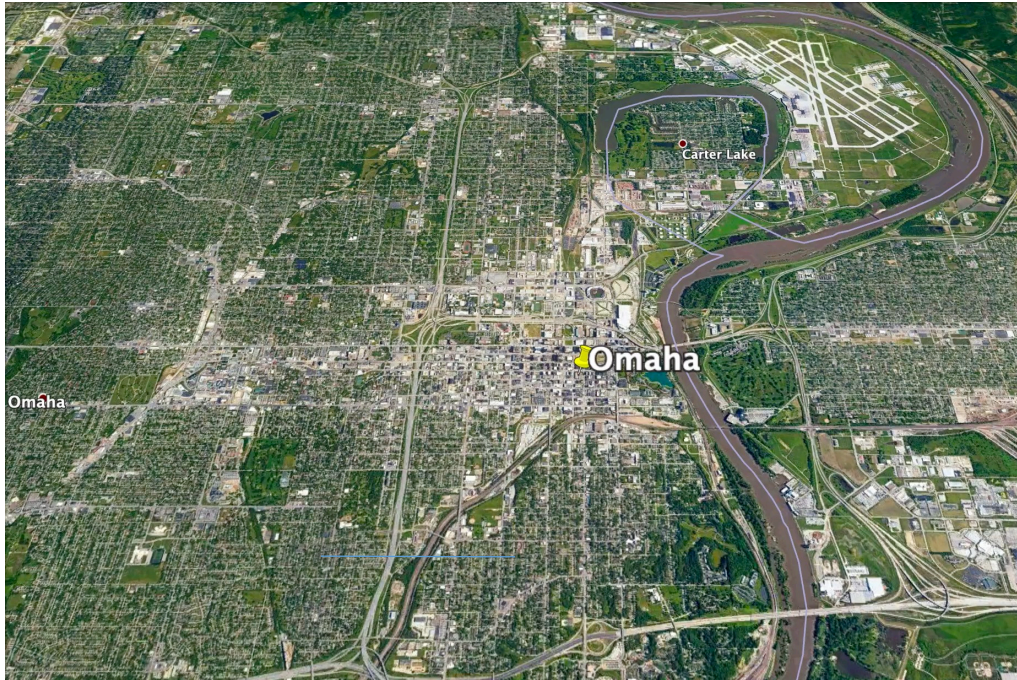
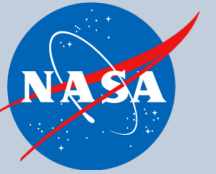
Soil Moisture Messages (topic is 'nost/soilmoisture')

Incoming Messages

All Messages As Text (topic is '#')

2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:38.894 [model] Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 17:24:17.687 [model] Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 16:28:46.144 ("name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": ["nost/manager/#", "nost/fire/#", "nost/ground/#", "type": "client"]})
Incoming Messages

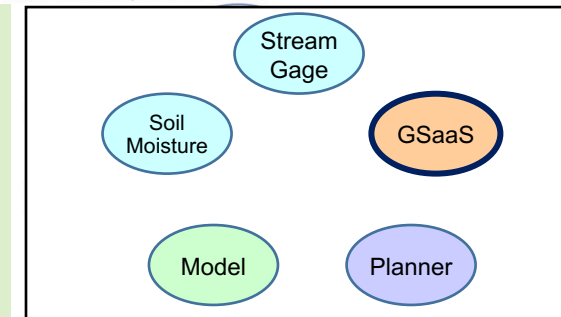
Schedule AWS Ground Stations to receive next VIIRS direct broadcast



Schedule AWS Ground Station to receive NPP direct broadcast at 17Z

Simulation Time: 2019-03-16 12:00Z

2021/3/5 17:4:14.649 [RETASK]: Finished computation, Output
2021/3/5 17:4:12.339 [RETASK]: Received new input, starting p
2021/3/5 17:4:12.339 [MODEL]: Sent 'new_trigger' message to
2021/3/5 17:4:12.330 [MODEL]: Forecast Triggers completed a
2021/3/5 17:4:12.328 [SOIL] Waiting for hour 00. Current Time
2021/3/5 17:4:9.646 [CLOCK]: Received simulation time tick, si
2021/3/5 17:4:9.633 [NWIS]: Publishing Trigger Data for 2019-
2021/3/5 17:4:0.77 [MODEL]: Performing data assimilation and
2021/3/5 17:3:55.879 [SOIL] Download for day 16. URL: https://
2021/3/5 17:3:55.871 [SOIL] Sending soil moisture KMZ files.
2021/3/5 17:3:55.864 [CLOCK]: Received simulation time tick,
2021/3/5 17:3:55.857 [NWIS]: Publishing Trigger Data for 2019
2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS Fl
2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URL
2021/3/5 17:2:41.576 [SOIL] Waiting for hour 00. Current Time



Retasking Messages (topic is 'nost/planner')

2021/3/1 12:5:5.843 ["message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc"]
2021/3/1 12:4:8.277 ["message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc"]
2021/3/1 12:3:11.125 ["message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc"]
2021/3/1 12:2:13.65 ["message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc"]
Incoming Messages

Forecast (Model) Messages (topic is 'nost/model/#')

2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc

NWIS Messages (topic is 'nwis/#')

Incoming Messages

NOS-T Manager Messages (topic is 'nost/manager/#')

2021/3/1 12:5:31.12 ["taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"}]
2021/3/1 12:5:18.630 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"}]
2021/3/1 12:5:3.835 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"}]
2021/3/1 12:4:49.471 ["name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"}]

GSaaS VIIRS Messages (topic is 'nost/GSaaS')

2021/3/1 12:5:23.145 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"

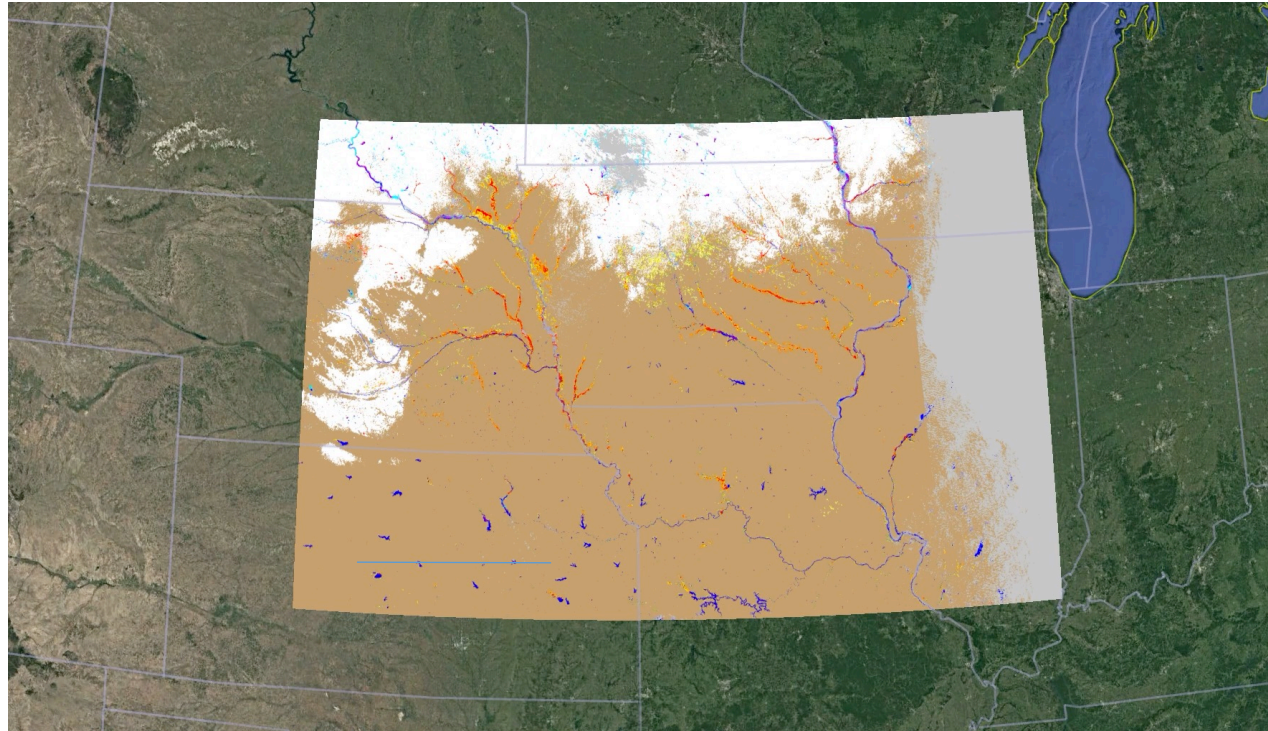
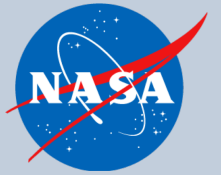
Soil Moisture Messages (topic is 'nost/soilmoisture/#')

Incoming Messages

All Messages As Text (topic is '#')

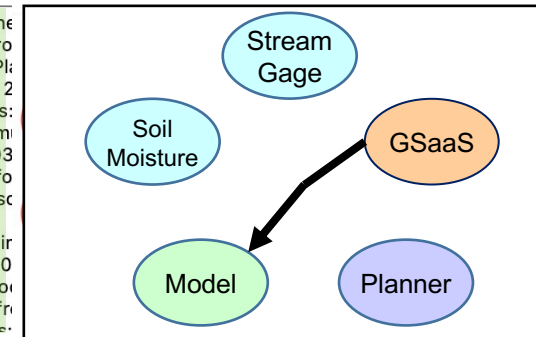
2021/3/1 17:39:27.563 ["message": "new_file_uploaded"]
2021/3/1 17:39:21.641 ["message": "new_file_uploaded", "filepath": "files/swe_output.nc"]
2021/3/1 17:31:38.894 [model] Received new input, starting processing
2021/3/1 17:31:37.845 ["message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc"]
2021/3/1 17:24:17.687 [model] Received new input, starting processing
2021/3/1 17:23:44.882 ["message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc"]
2021/3/1 16:28:46.144 ["name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": ["nost/manager/#", "nost/fire/#", "nost/ground/#", "type": "client"]}]

Next VIIRS Flood Extent Product



Simulation Time: 2019-03-16 17:00Z

2021/3/5 17:4:14.649 [RETASK]: Finished computation, Output ne
2021/3/5 17:4:12.339 [RETASK]: Received new input, starting pro
2021/3/5 17:4:12.339 [MODEL]: Sent 'new_trigger' message to Pl
2021/3/5 17:4:12.330 [MODEL]: Forecast Triggers completed at 2
2021/3/5 17:4:12.328 [SOIL]: Waiting for hour 00. Current Time is:
2021/3/5 17:4:9.646 [CLOCK]: Received simulation time tick, sim
2021/3/5 17:4:9.633 [NWIS]: Publishing Trigger Data for 2019-03
2021/3/5 17:4:0.77 [MODEL]: Performing data assimilation and fo
2021/3/5 17:3:55.879 [SOIL]: Download for day 16. URL: https://sc
2021/3/5 17:3:55.871 [SOIL]: Sending soil moisture KMZ files.
2021/3/5 17:3:55.864 [CLOCK]: Received simulation time tick, sir
2021/3/5 17:3:55.857 [NWIS]: Publishing Trigger Data for 2019-0
2021/3/5 17:3:43.441 [MODEL]: Finished downloading VIIRS Floo
2021/3/5 17:3:43.438 [MODEL]: Received VIIRS Flood File URL fr
2021/3/5 17:3:41.576 [SOIL]: Waiting for hour 00. Current Time is:



Retasking Messages (topic is 'nost/planner')

2021/3/1 12:5:5.843 ("message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc")
2021/3/1 12:4:8.277 ("message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc")
2021/3/1 12:3:11.125 ("message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc")
2021/3/1 12:2:13.65 ("message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc")

Incoming Messages

Forecast (Model) Messages (topic is 'nost/model/#')

2021/3/1 12:4:53.409 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.406 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc

NWIS Messages (topic is 'nwis/+')

Incoming Messages

NOS-T Manager Messages (topic is 'nost/manager/+')

2021/3/1 12:5:31.12 ("taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"},
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:5:22.597 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",

GSaaS VIIRS Messages (topic is 'nost/GSaaS')

2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully!"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.828 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"

Soil Moisture Messages (topic is 'nost/soilmoisture/+')

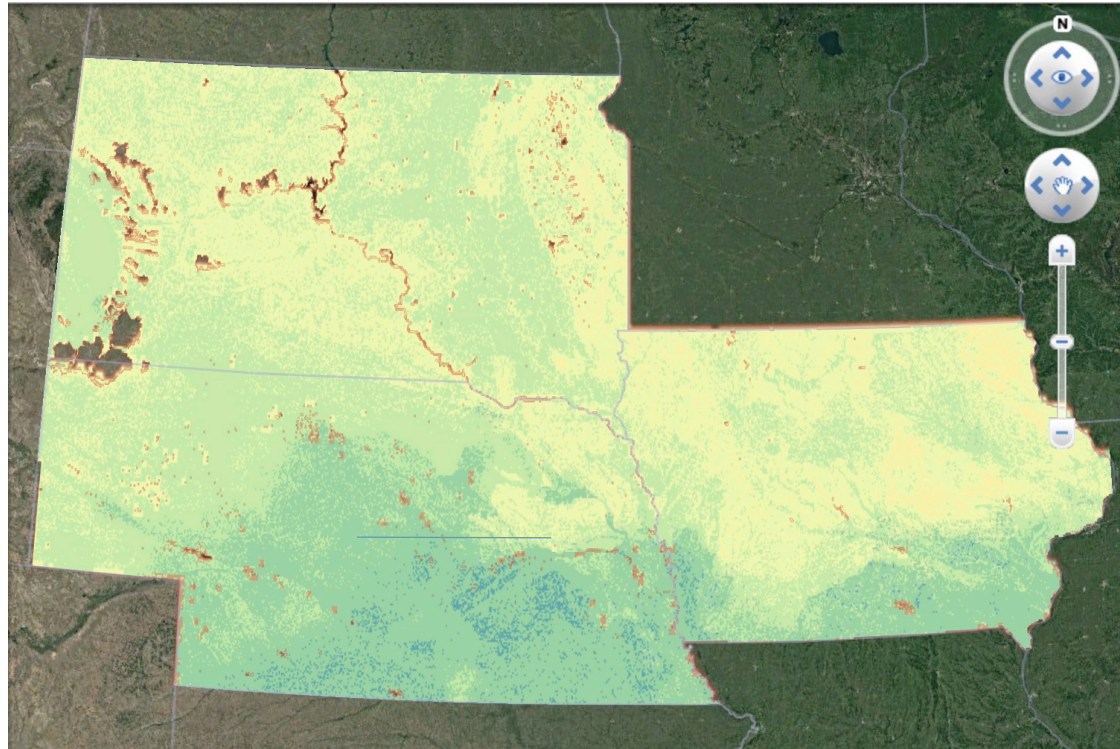
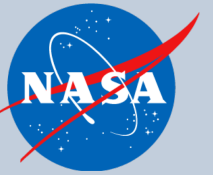
Incoming Messages

All Messages As Text (topic is '#')

2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:38.804 [model]: Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 17:24:17.687 [model]: Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 15:28:46.144 ("name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": ["nost/manager/#", "nost/fire/#", "nost/ground/#", "type": "client"]})

Downlink via AWS Ground Station
Process flood product in the cloud

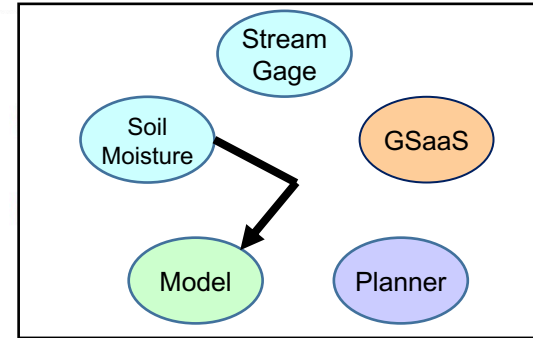
Next Upscaled Soil Moisture



Generate upscaled soil-moisture product from in-situ network

Simulation Time: 2019-03-17 00:00Z

2021/3/5 17:4:37.882 [GSaaS]: Sent VIIRS Flood File Notification Me
2021/3/5 17:4:37.872 [CLOCK]: Received simulation time tick, simula
2021/3/5 17:4:37.869 [NWIS]: Publishing Trigger Data for 2019-03-1
2021/3/5 17:4:29.886 [GSaaS]: Processing VIIRS Flood Product Com
2021/3/5 17:4:27.88 [SOIL] Waiting for hour 00. Current Time is: 12
2021/3/5 17:4:23.881 [GSaaS]: Receiving VIIRS Direct Broadcast.
2021/3/5 17:4:23.881 [GSaaS] Tasking Amazon GS to receive next VI
2021/3/5 17:4:23.877 [CLOCK]: Received simulation time tick, simula
2021/3/5 17:4:23.869 [NWIS]: Publishing Trigger Data for 2019-03-1
2021/3/5 17:4:14.649 [RETASK]: Finished computation, Output new
2021/3/5 17:4:12.339 [RETASK]: Received new input, starting proces
2021/3/5 17:4:12.339 [MODEL]: Sent 'new_trigger' message to Plann
2021/3/5 17:4:12.330 [MODEL]: Forecast Triggers completed at 2019
2021/3/5 17:4:12.328 [SOIL] Waiting for hour 00. Current Time is: 06
2021/3/5 17:4:9.646 [CLOCK]: Received simulation time tick, simula



Retasking Messages (topic is 'nost/planner')

2021/3/1 12:4:8.277 ("message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc")
2021/3/1 12:3:11.125 ("message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc")
2021/3/1 12:2:13.65 ("message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc")
Incoming Messages

Forecast (Model) Messages (topic is 'nost/model/#')

2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc

NWIS Messages (topic is 'nwis/#')

Incoming Messages

NOS-T Manager Messages (topic is 'nost/manager/*')

2021/3/1 12:5:31.12 ("taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"},
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:5:22.597 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
2021/3/1 12:5:22.291 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",

GSaaS VIIRS Messages (topic is 'nost/GSaaS')

2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"

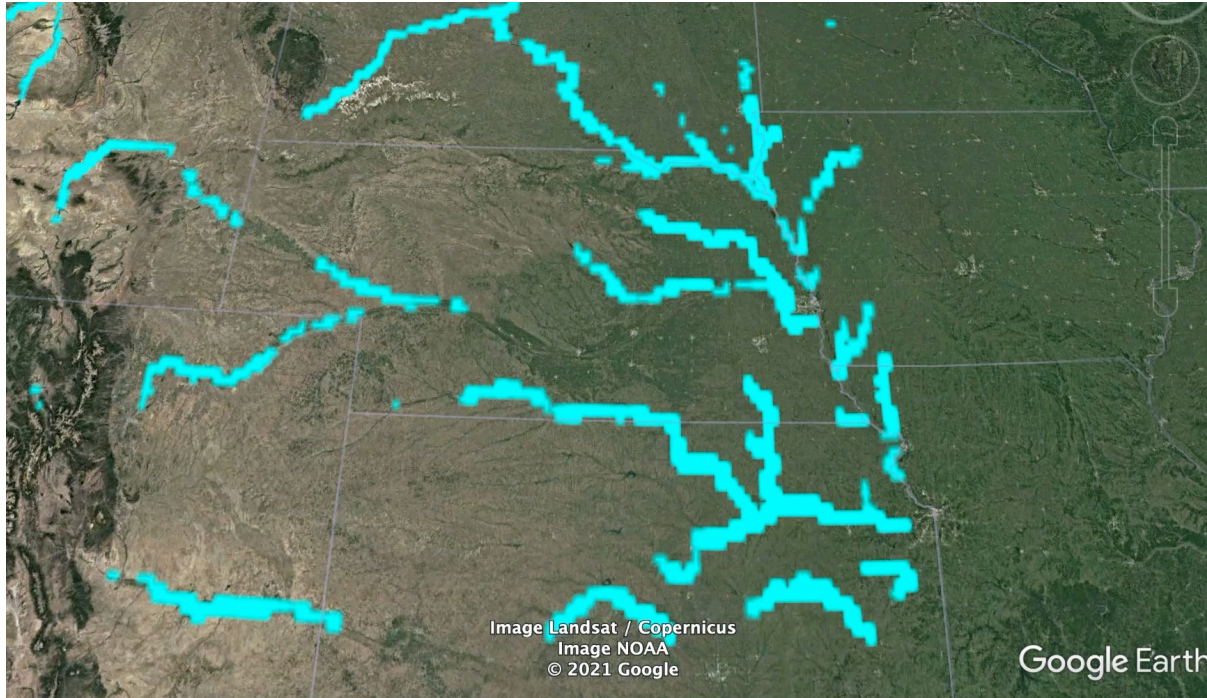
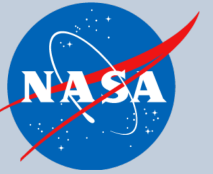
Soil Moisture Messages (topic is 'nost/soilmoisture/*')

Incoming Messages

All Messages As Text (topic is '#')

2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:38.894 [model]: Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 17:24:17.687 [model]: Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 15:28:46.144 ("name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050/", "subscriptions": ["nost/manager/#", "nost/fire/#", "nost/ground/#"], "type": "client"})

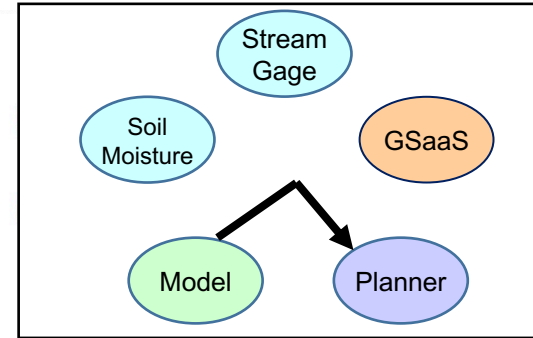
Assimilate Data and re-forecast



Assimilate and re-forecast
Repeat workflow

Simulation Time: 2019-03-17 00:00Z

```
2021/3/5 17:4:55.299 [SOIL] Download for day 17. URL: https://s
2021/3/5 17:4:55.284 [SOIL] Sending soil moisture KMZ files.
2021/3/5 17:4:55.267 [CLOCK]: Received simulation time tick, si
2021/3/5 17:4:55.258 [NWIS]: Publishing Trigger Data for 2019-
2021/3/5 17:4:40.564 [MODEL]: Finished downloading VIIRS Flo
2021/3/5 17:4:40.557 [MODEL]: Received VIIRS Flood File URL f
2021/3/5 17:4:40.554 [SOIL] Waiting for hour 00. Current Time i
2021/3/5 17:4:37.882 [GSaaS]: Sent VIIRS Flood File Notification
2021/3/5 17:4:37.872 [CLOCK]: Received simulation time tick, si
2021/3/5 17:4:37.869 [NWIS]: Publishing Trigger Data for 2019-
2021/3/5 17:4:29.886 [GSaaS]: Processing VIIRS Flood Product
2021/3/5 17:4:27.88 [SOIL] Waiting for hour 00. Current Time is:
2021/3/5 17:4:23.881 [GSaaS]: Receiving VIIRS Direct Broadcast
2021/3/5 17:4:23.881 [GSaaS] Tasking Amazon GS to receive ne
2021/3/5 17:4:23.877 [CLOCK]: Received simulation time tick, si
```



Retasking Messages (topic is 'nost/manager/*')

```
2021/3/1 12:5:5.843 ("message": "new_trigger", "filepath": "filedrop/run/2019031900/trigger_201903190000.nc")
2021/3/1 12:4:8.277 ("message": "new_trigger", "filepath": "filedrop/run/2019031800/trigger_201903180000.nc")
2021/3/1 12:3:11.125 ("message": "new_trigger", "filepath": "filedrop/run/2019031700/trigger_201903170000.nc")
2021/3/1 12:2:13.65 ("message": "new_trigger", "filepath": "filedrop/run/2019031600/trigger_201903160000.nc")
```

Incoming Messages

Forecast (Model) Messages (topic is 'nost/model/*')

```
2021/3/1 12:4:53.408 [model] Trigger file generation is complete
2021/3/1 12:4:53.408 [model] Generating trigger: trigger_201903171800.d01.nc
2021/3/1 12:4:53.407 [model] Generating trigger: trigger_201903171200.d01.nc
2021/3/1 12:4:53.405 [model] Generating trigger: trigger_201903170600.d01.nc
2021/3/1 12:4:53.404 [model] Generating trigger: trigger_201903170000.d01.nc
2021/3/1 12:4:53.403 [model] Generating trigger: trigger_201903161800.d01.nc
2021/3/1 12:4:53.401 [model] Generating trigger: trigger_201903161200.d01.nc
```

NWIS Messages (topic is 'nwis/*')

Incoming Messages

NOS-T Manager Messages (topic is 'nost/manager/*')

```
2021/3/1 12:5:31.12 ("taskingParameters": {"simStopTime": "2019-03-19T15:00:00+00:00"})
2021/3/1 12:5:18.630 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T12:00:00+00:00", "time": "2021-03-15T16:05:14.676674+00:00"})
2021/3/1 12:5:3.835 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T06:00:00+00:00", "time": "2021-03-15T16:04:59.876586+00:00"})
2021/3/1 12:4:49.471 ("name": "Manager", "description": "Manages simulation state and provides synchronized timing.",
"properties": {"simTime": "2019-03-19T00:00:00+00:00", "time": "2021-03-15T16:04:45.477863+00:00"})
```

GSaaS VIIRS Messages (topic is 'nost/GSaaS/*')

```
2021/3/1 12:5:23.149 "Completed processing of the SDR VIIRS algorithm successfully"
2021/3/1 12:5:22.976 "Uploading level 3 fire imagery to Amazon S3 for distribution"
2021/3/1 12:5:22.826 "L3: VIIRS Fire Imagery: Detected command SUCCESS. Return Code: 0"
2021/3/1 12:5:22.669 "Overlaying fires on image product"
2021/3/1 12:5:22.597 "L3: VIIRS Fire Imagery: Child job VIIRS Fire Imagery started. Processing."
2021/3/1 12:5:22.417 "All level 2 processing completed. Starting Level 3."
2021/3/1 12:5:22.291 "Uploading level 2 Flood, Fire and Polar2Grid files to Amazon S3 for distribution"
```

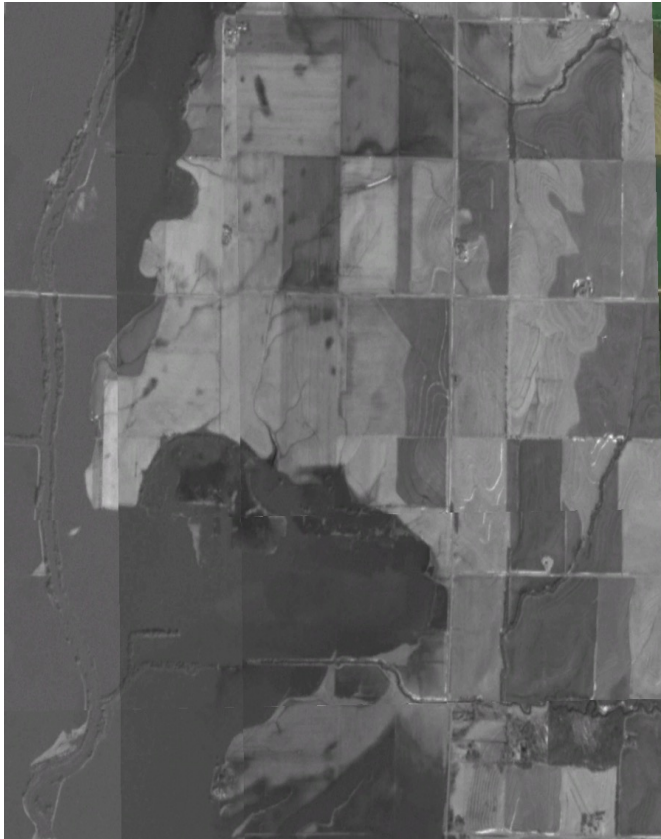
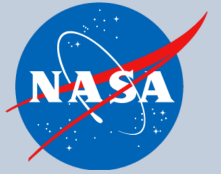
Soil Moisture Messages (topic is 'nost/soilmoisture/*')

Incoming Messages

All Messages As Text (topic is '#')

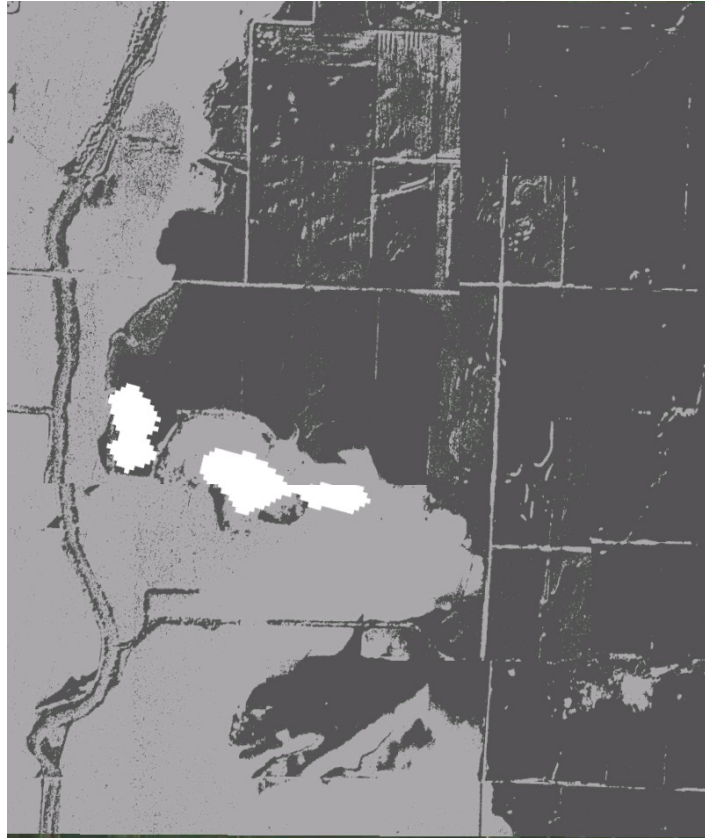
```
2021/3/1 17:39:27.563 ("message": "new_file_uploaded")
2021/3/1 17:39:21.641 ("message": "new_file_uploaded", "filepath": "files/swe_output.nc")
2021/3/1 17:31:39.894 [model]: Received new input, starting processing
2021/3/1 17:31:37.845 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 17:24:17.687 [model]: Received new input, starting processing
2021/3/1 17:23:44.882 ("message": "new_trigger", "filepath": "filedrop/baseline/2019031600/trigger_201903160000.nc")
2021/3/1 16:28:46.144 ("name": "Scoreboard Node", "description": "Displays a visualization of the simulation.", "properties": {"resource": "http://localhost:8050", "subscriptions": ["nost/manager/#", "nost/fire/#", "nost/ground/#"], "type": "client"})
```

Enables Targeted images of flood peaks



High resolution images of flood peaks

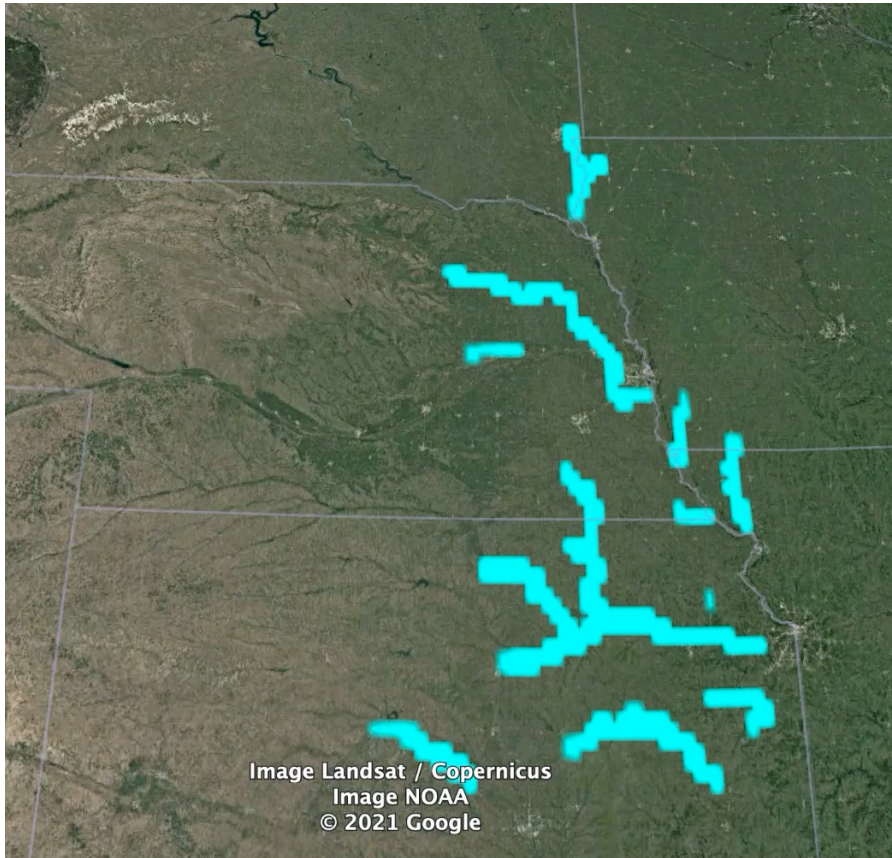
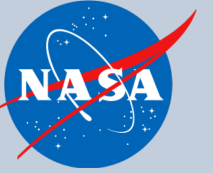
Dove images courtesy Planet Labs



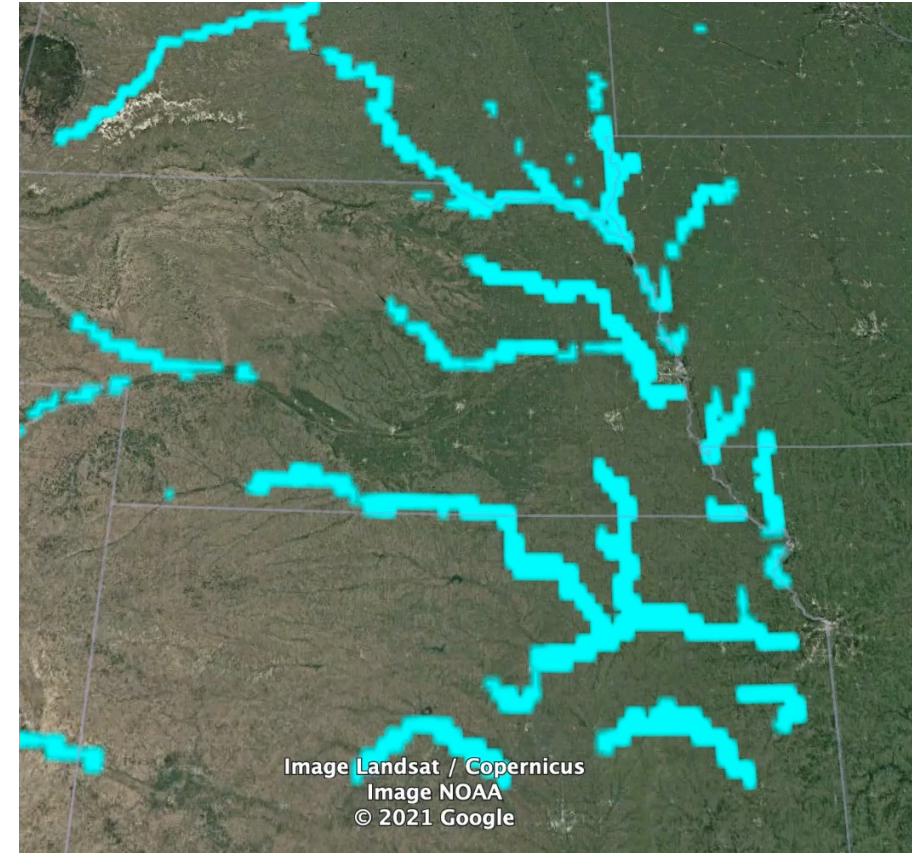
Surface water extent

- Model-driven dynamic retasking provides high resolution visible imagery of flood peaks as the flood is unfolding.
- Provides better resolution of flood plains and more precise surface water extent at those locations.

Model-directed data improves forecast



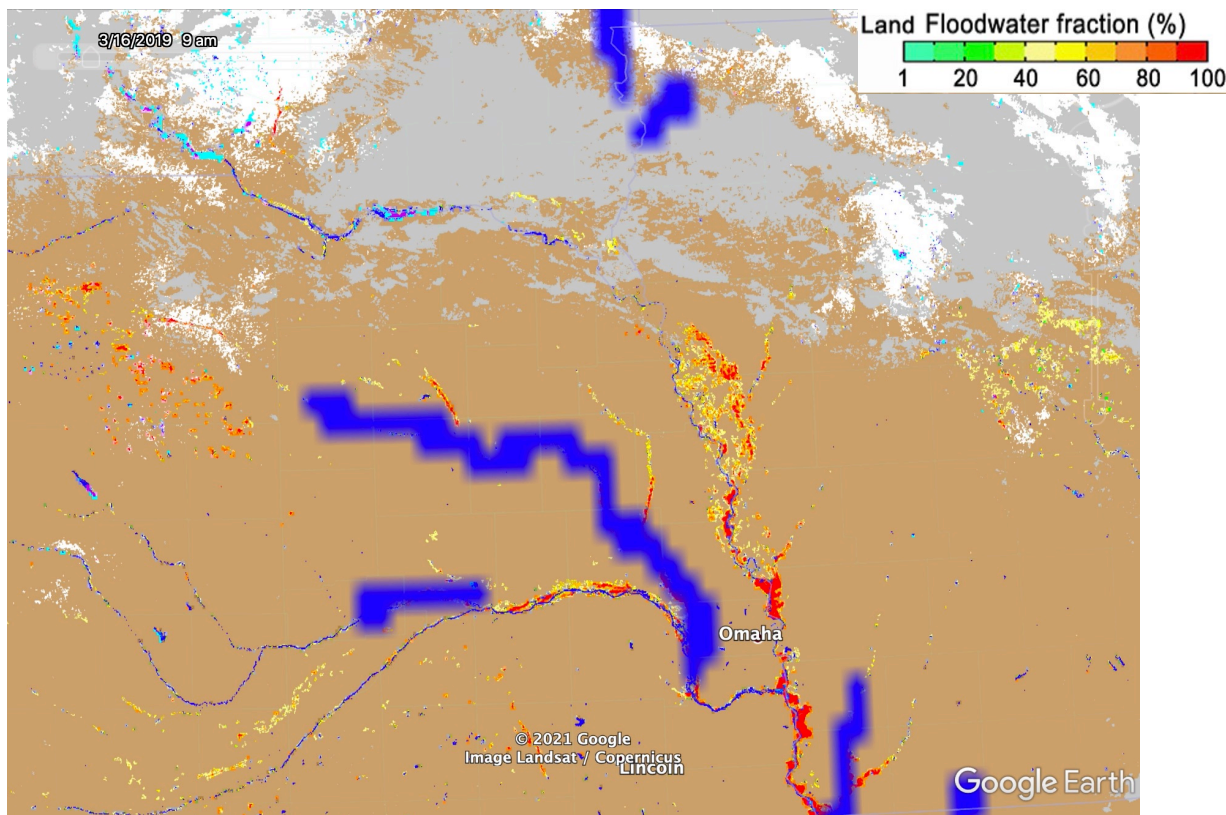
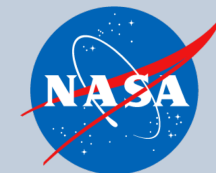
Triggers without directed observations



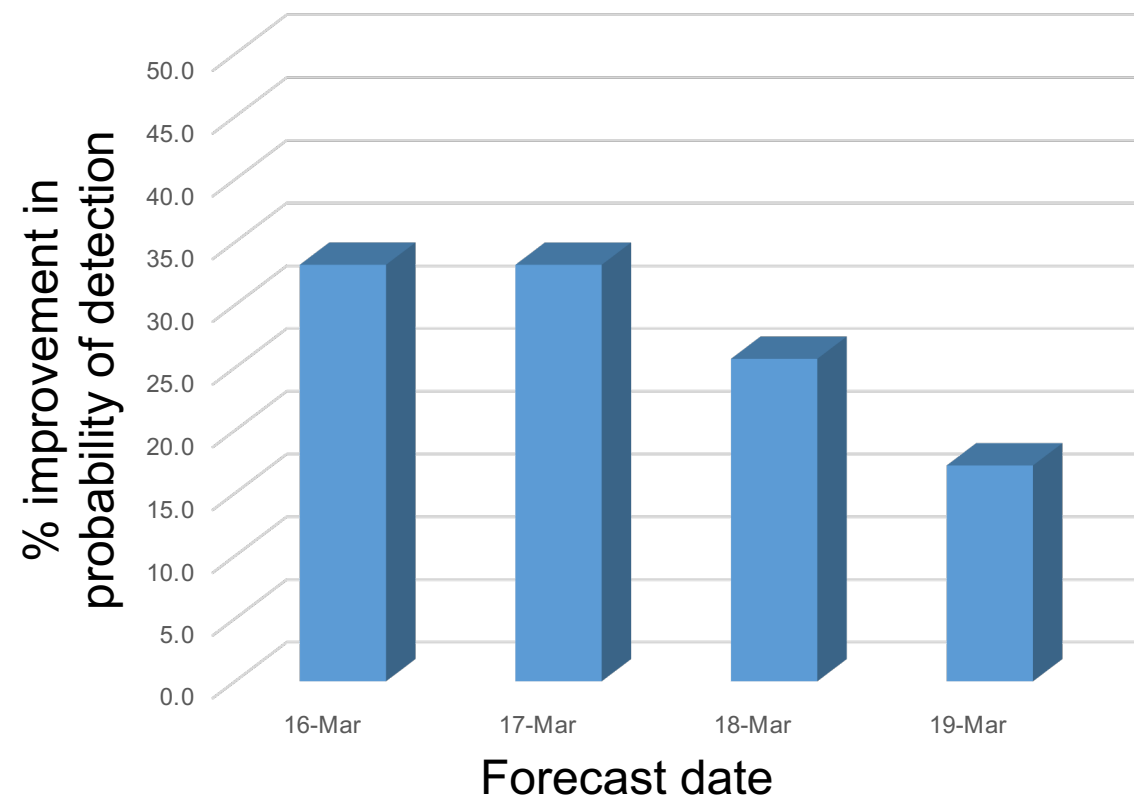
Triggers with directed observations

Forecast triggers include more flood areas after assimilating all directed observations

NOS intelligent observing strategy improves model forecast

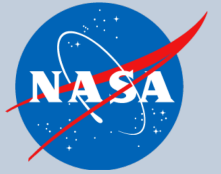


Red ground truth (high confidence floods)
Dark blue forecast without assimilation
Light blue forecast with NOS-directed observations

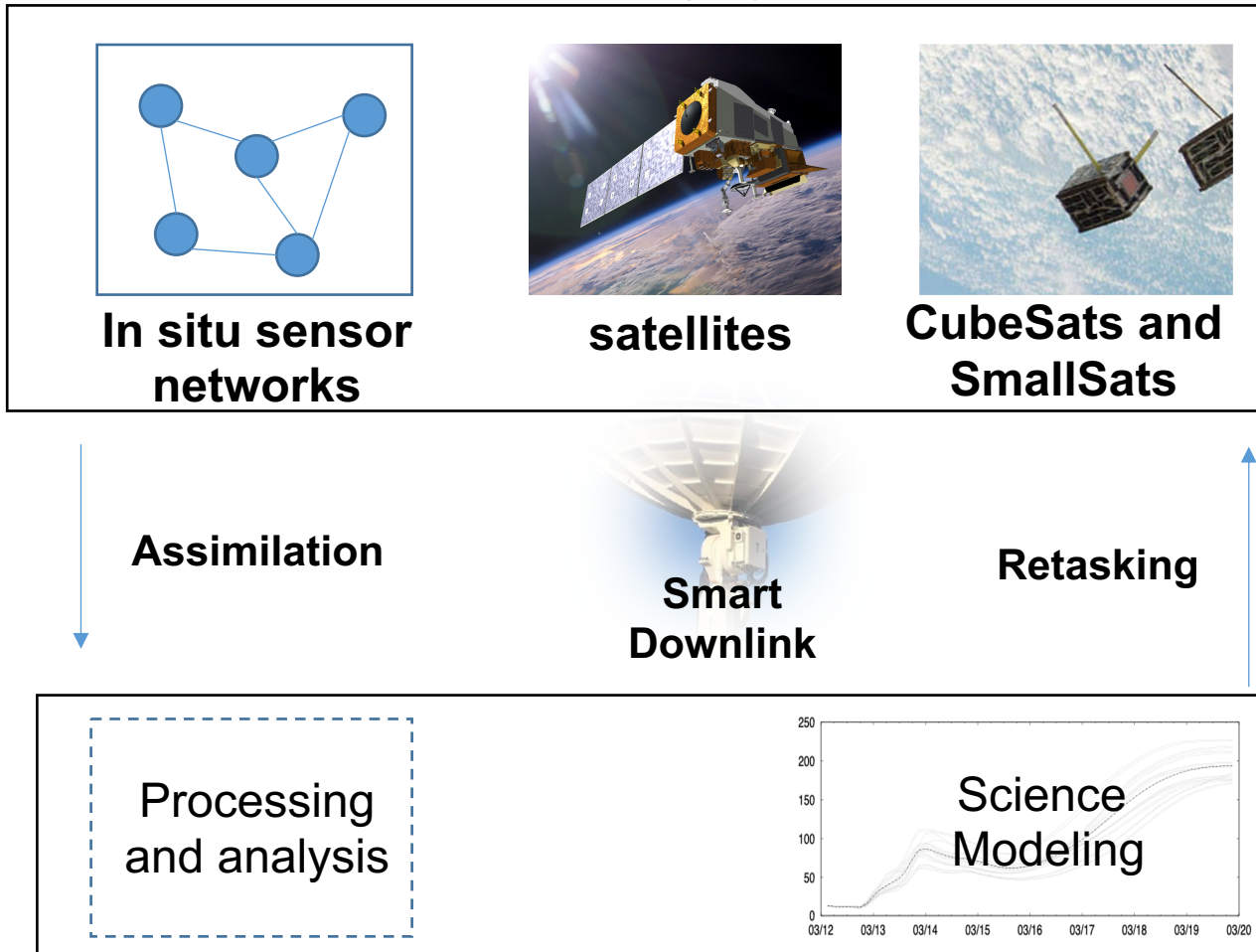


Forecast assimilating all NOS-directed observations (VIIRS, soil moisture, surface water extent) does ~30% better than same forecast without directed observations.

Testbed provides environment for exploring NOS concepts



Observing System



- First demonstration of a New Observing Strategy in the NOS Testbed
- Coordinates models, in situ, and remote sensing platforms to observe triggered and forecasted events.
- Future scenarios can consider other observing systems and science objectives

